SELECTION OF ALTERNATE VERTICAL EXCHANGE MECHANISMS AND ITS EFFECTS ON MARKET PRICE

BY

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A wide variety of alternate vertical exchange mechanisms have developed and exist today within the U.S. agricultural sector. Examples include futures or other types of forward contracts, forward or backward vertical integration, tying, cooperatives, market orders and formula pricing. The present study addressed the questions of why firms choose contracting or spot markets, and why prices differ between these two vertical exchange mechanisms.

A theoretical framework was developed at the firm level which was used to illustrate why differences in price and selection of vertical exchange mechanisms exist. Based on firm maximizing principles, it was shown how firms would evaluate profits from each mechanism because different services are associated with contracting and spot markets. Firms pay for services they receive and are paid for services they provide. These factors affect their profits, and this was also demonstrated theoretically.

The principles of hedonic price analysis were shown to be applicable to estimation of individual implicit service prices associated with each

vertical exchange mechanism. These characteristics were called "services" and were each elements of "four categories of incentives" of risk reduction, transaction costs, market power or technology.

Implicit service prices for factors associated with the spot market or contracting were estimated for the Hastings, Florida, chip potato market. It was found that there were different service factors associated with each market, and that these implicit prices contributed to explaining prices in each vertical exchange mechanism, and also in explaining differences between spot market and contract prices.

Finally, it was hypothesized that different firms found different vertical exchange mechanisms optimal because of differences in their cost curves. Tests were performed to determine if firms choosing contracts possessed different characteristics from those using the spot market. Firm differences were found between the two groups which constituted evidence of differences in cost curves.

The overall contribution of this study was the development and testing of a methodology for evaluating differences in firm and market behavior in agricultural sectors characterized by more than one available vertical exchange mechanism. Economists and policy makers dealing with markets which are thinly traded, for example, should find the techniques of hedonic price analysis of the service characteristics associated with each vertical exchange mechanism to be a useful adjunct to other tools of analysis.

Participants in the Hastings, Florida, chip potato market should find the present study useful because it helped explain differences in price between the spot market and contracting. It also provided information on the estimated value of implicit service prices associated with

each vertical exchange mechanism, and this information should help growers decide what mechanism or combination of mechanisms is optimal for them.

CHAPTER I
INTRODUCTION

Agricultural markets have changed over time, along with the nature and scope of U.S. agricultural production. In addition to spot markets, a wide variety of alternate vertical exchange mechanisms have developed and exist today where once only local auctions existed. Examples include futures or other types of forward contracts, forward or backward vertical integration, tying, cooperatives, market orders and formula pricing. Agricultural economists are interested in and concerned with this changing composition and technology of vertical exchange mechanisms. The causes and consequences of usage of these alternate exchange mechanisms is one particular concern among many economists and policy makers.

> The great concerns seem to be associated with markets which once were broadly traded, but which changed when vertically integrated systems or longer term contracts, especially reference or formula price contracts, become dominant. As the residual market decreased, insecurity increased regarding the representativeness of transacted and reported prices, and the potential ease of price manipulation, the adequacy of market information, and the risk of having sufficient buyers or sellers available at any time to insure an equitable price. [Hayenga, 1979, p. 1]

In addition to the "thin market" issue and problems of pricing efficiency as described above by Hayenga, there are many other general areas of interest and sensitivity in examination of use of alternate vertical exchange mechanisms. Some of these include allocative efficiency, and distribution of gains which might be realized through use of alternate vertical exchange mechanisms.

There are also technical problems in analysis of use of alternate vertical exchange mechanisms. What are the appropriate economic tools to use in analysis of alternate vertical exchange mechanisms? What data are needed in order to conduct a desired analysis? How should the results be interpreted?

The nature of exchange between buyers and sellers needs further investigation concerning the reasons firms choose different vertical exchange mechanisms, and the consequences of these choices, from both the individual's and market's perspective. In general terms, vertical exchange mechanisms can be classified into three categories: spot markets, contracting and vertical integration. Little has been done econometrically to investigate the reasons for and consequences of firms' selection of vertical exchange mechanisms [Hayenga, 1979]. However, many authors have suggested explanations for the appearance of these alternatives to spot markets. These explanations have centered around one or more imperfections in spot markets, such as high costs to locate buyer or seller and other transaction costs, desire to reduce price and/or quantity risks and market power. "[A market] does not provide information regarding price, quality and location of the commodity at zero cost" [Lee, 1974, p. 460]. Williamson [1973], Stigler [1951] and Warren-Boulton [1978] have also written about different forms of spot market failure. However, there is no unifying, quantified framework within which to measure the effects of these factors in concert at this time. Yet there is a strongly felt need among industrial organization and other economists to develop such a framework within which to analyze all factors affecting the selection of alternate vertical exchange mechanisms, and the factors determining

price differences among the different vertical exchange mechanisms available to sellers and buyers.

> One of the major problems in research on the vertical organization of agricultural marketing systems has been the inability to develop a clear conceptual approach to the subject. While there has been a substantial amount of research on vertical integration, contract farming, vertical coordination and vertical cooperation, much of this work has suffered for the lack of a central theoretical focus. [Helmberger et al., 1980, p. 1]

Problems to Be Addressed in This Study

Within this broad context of selection of alternate vertical exchange mechanisms, the problems selected for specific examination in this study are: why do firms make their selection of available vertical exchange mechanisms, and what are the consequences of non-use of spot market exchanges upon prices in affected markets?

This study examines the process of the firm's selection of vertical exchange mechanisms in the context of traditional microeconomic theory. It assumes profit or utility maximizing firms and suggests that different factors offered through alternate vertical exchange mechanisms affect output through the firm's objective function. It is hypothesized that payments are made and received for the services associated with use of two vertical exchange mechanisms, contracting and the spot market. A hedonic price analysis is performed upon the Hastings, Florida, chip potato market to isolate and measure these implicit prices. An analysis is also performed to test the hypothesis that firms selecting different vertical exchange mechanisms possess different characteristics, representing differences in their respective objective functions.

Objectives

(1) Develop a conceptual procedure which illustrates how firms evaluate different vertical exchange mechanisms: what factors they consider, how those factors affect their production decisions and how they choose among available vertical exchange mechanisms.

(2) Develop and test an empirical model based on the conceptual model above in which characteristics of the spot market versus contracting are related to observed prices in the Hastings, Florida, market for chip potatoes.

(3) Compare firm characteristics of growers who use the spot market versus contracting to the firm's selection of vertical exchange mechanisms in the Hastings, Florida, chip potato market.

(4) Evaluate pricing performance in these markets on the basis of the models tested in objectives (2) and (3).

Hypotheses to Be Tested

(1) The spot market for chip potatoes in Hastings, Florida, possesses different characteristics from those available through contracting (from both buyer's and seller's perspective) and firms choose vertical exchange mechanism on the basis of the price and quantity of services offered through each vertical exchange mechanism.

(2) These different services explain (at least in part) the observed exchange price in the spot market and contracting for potatoes in the Hastings, Florida, area.

(3) Firm characteristics influence which vertical exchange mechanism growers in the Hastings, Florida, area will select because different firms experience different productivities of services.

Methodology

The above hypotheses will be tested using both primary and secondary data concerning the Hastings chip potato market. A hedonics type of price analysis will be used to analyze the spot market and contracting, as a test of hypotheses one and two above, and from these tests conclusions concerning pricing efficiency of the markets will be formed. A Logit analysis will be utilized to test hypothesis number three, and conclusions regarding this hypothesis will pertain to factors affecting the firm's selection of alternate vertical exchange mechanisms.

Subsequent Chapters

Chapter II will provide a review of pertinent literature concerning incentives for firms to use different vertical exchange mechanisms. Chapter III presents the basic approach utilized in the present study. Chapter IV is an empirical application of the methodology developed in Chapter III, and analysis of results and conclusions are also found within this Chapter. Other possible applications and suggestions for further research complete the study in Chapter V.

CHAPTER II
BACKGROUND AND LITERATURE REVIEW

Introduction

The literature review in this Chapter will serve two purposes: (1) to delineate the range of incentives which have been suggested as providing the basis for firms to choose alternate vertical exchange mechanisms, and (2) to demonstrate that as of this writing, no known source has considered all of these possible incentives in an econometric model.

The first part of this Chapter will examine the different types of incentives which various authors have suggested. They will be grouped into four general categories: transaction costs, technology, risk reduction and market power. The latter portion examines various approaches utilized by different authors. These have been divided as descriptive industry studies, quantitative analyses, simulations and empirical applications.

Although explanation of price differences among alternate vertical exchange mechanisms is the primary purpose of this study, in order to make this evaluation it is first necessary to develop a framework for examination of firm behavior. If all firms in an industry were identical, only one price and one vertical exchange mechanism would prevail. Thus, it is necessary to examine both firm characteristics and factors unique to each vertical exchange mechanism to understand why firms

behave in observed patterns, and why prices in each vertical exchange mechanism may differ.

The following review of related literature will bring to light suggestions of different authors regarding firm and vertical exchange mechanism factors which they have hypothesized as explanations for firm and market behavior.

Incentives for Firm Selection of Alternate Vertical Exchange Mechanisms

Transaction Costs

The term, transaction costs, is usually referred to loosely as "all costs associated with the act of trade . . ." [Mayshar, 1979, p. 673]. This broad definition has produced criticisms: "But despite the growing realization that transaction costs are central to the study of economics, skeptics remain. Stanley Fischer's complaint is typical: 'Transaction costs have a well-deserved bad name as a theoretical device . . . [partly] because there is a suspicion that almost anything can be rationalized by invoking suitably specified transaction costs.' Put differently, there are too many degrees of freedom; the concept wants for definition" [Williamson, 1975, p. 233]. Most authors writing on the subject, however, include factors such as search costs, costs associated with agreeing on specification of the object exchanged, cost of verifying its compliance with agreed-upon speculations and costs of breaking agreements.

Transaction costs seem to be the most frequently suggested incentive for firms to forego spot markets and utilize contracts or

vertically integrate. There have been few empirical attempts to verify the validity of these arguments, however.

> The recent growth of centrally coordinated vertical marketing systems has prompted market scholars to propose that such systems have inherent advantages which allow them to improve their operational efficiency and reduce costs of distribution. However, even though several models have been developed to explain the advantages of central coordination in vertical marketing systems, studies of centrally coordinated systems have been mainly descriptive with little or no testing of formal hypotheses. [Etgar, 1976, p. 12]

Ronald Coase has also presented logical arguments supporting the importance of transactions costs at periodic intervals over the past 40 years [Coase, 1937, 1960]. Oliver E. Williamson is another prominent advocate of transaction costs as the explanation for firm's rejection of spot markets [Williamson, 1975]. His arguments suggest that firms' adoption of alternate vertical exchange mechanisms is evidence of a type of "market failure" in which firms find the costs of using the available market exceed the costs of private arrangements for exchange. Information and search costs are among the primary culprits cited. These arguments are not empirical conclusions, however, but logical deductions based on the premise that a "perfect market" has no costs associated with the transaction of business, and that the presence of transaction costs is, ipso facto, evidence of "market failure." Implicit in this argument is the assumption that some form of spot market carries the potential of "perfection" and that a market where there were no transaction costs would be some type of spot market.

Cheung [1969] varies only slightly from this line of reasoning. He, like Williamson, argues that there are costs associated with establishing a product's true characteristics and in locating a party who possesses a product with those desired characteristics. He also

concludes through deductive reasoning that "imperfections" in spot markets prevent them from being the most efficient means of these parties meeting and exchanging the product.

Numerous other authors have contributed to this area of literature, and the interested reader is encouraged to consult the bibliography for additional references. In general, however, the main contribution of this group of books and articles to the present study is to suggest sources of "problems" spot markets might experience, which would provide incentives for firms to search for alternative means of vertical exchange. Viewed as the "cost of doing business" it becomes apparent that there will be costs associated with transactions in any vertical exchange mechanism, and these general discussions of what some of those costs might be (in any industry) provided a logical framework within which to select factors to empirically test in this study. It should be noted, however, that none of these writings address the question of why some firms within the same industry will change from spot markets to contracting or vertical integration, while other firms do not change mechanisms.

Technology

George Stigler [1951] was the first to suggest that firms would utilize different vertical exchange mechanisms during different stages of development of the industry, and that this development was predicated upon technological change. He suggested the factors to consider were firm age and industry volume. He suggested that when a new industry was emerging, there would not be certain sources of supply of its needed inputs because of new technological requirements. In order to secure

these needed inputs, therefore, these new firms would be forced to produce their own inputs. If the new industry prospered, however, Stigler argued that increased volume of demand for these new inputs would cause the development of firms to provide those inputs, and specialization in production would occur, cuasing the original producers of those inputs to buy them from the specialized suppliers instead. Finally, Stigler suggested that in its "old age" the industry would again be forced to vertically integrate in order to supply itself with those specialized inputs because as demand for those inputs died, the specialized firms would exit from the industry. Specifically, Stigler felt that technological incentives for firms to vertically integrate were based on the fact that the new industry required inputs which were not already available in the market; thus, the idea that technological change was the motivator.

Oliver E. Williamson has presented similar arguments:

> In the absence of a more substantial theoretical foundation, vertical integration, as a public policy matter, is typically regarded as having dubious if not outright antisocial properties. Technological interdependencies or, possibly, observational economies, constitute the principal exceptions.
>
> The technological interdependency argument is both the most familiar and the most straight-forward: successive processors which, naturally, follow immediately in time and place dictate certain efficient manufacturing configurations; these, in turn, are believed to have common ownership implications. Such technical complementarity is probably more important in flow process operations (chemicals, metals, etc.) than in separable component manufacture. [Williamson, 1971, p. 112]

Numerous other authors have related technological economies to firm efficiency or market structure. Since they did not deal directly with the issue of incentives for firms to forego spot markets, they will not be discussed here. These authors include Esposito and

and Exposito [1974], Bosworth [1978] and Faris [1965]. Faris does, however, suggest that firms may accomplish greater efficiency by foregoing use of spot markets:

> A few of the larger farm operators are undertaking some of the functions of suppliers through acquiring small dealerships for some farm supplies . . . . The growth of local supply cooperatives has come about because of the development of large regional supply cooperatives . . . . The major savings do not appear to arise at the local level. It is in the area of manufacturing, rather than wholesaling, where the role of cooperatives becomes most important in the relationship among buyers and sellers. [Faris, 1965, p. 1238]

In conclusion, it has been suggested through logical reasoning that changes in technology might either force firms to utilize vertical integration [Stigler, 1951] or that increased efficiency is possible when other vertical exchange mechanisms are used instead of spot markets. Although they do not lead directly to empirical testing, these ideas suggest factors which should be examined in construction of an empirical model: development of new technologies and economies of scale in manufacture and distribution. It should be noted that Stigler's suggestions could be empirically tested, but they explain uniform firm behavior within an industry, not the differences in firm behavior, which is of interest in the present study.

Risk Reduction

Proponents of the school of thought who argue that transaction costs explain firm abandonment of spot markets would probably argue that risk is one type of transaction cost. Likewise, advocates of the risk reduction school of thought feel that risk is all-pervasive and observed behavior can be explained on the basis of risk reduction. Several authors have demonstrated mathematically how price and/or quantity

variation in inputs or output in production can provide an incentive for firms to internalize a given market exchange [Pleeter and Horowitz, 1980; Baron, 1970; Carlton, 1977; Blair, 1974]. These arguments rest upon either increased efficiencies of resource and plant capacity use, increased expected profits or risk aversion on the part of the producer or buyer.

Other approaches have introduced uncertainty or other types of imperfect information into the firm's decision-making framework and have demonstrated how this imperfect information affects the firm's output decisions [Arrow, 1975; Carlton, 1979a; Logan, 1966]. They suggested that by adopting alternatives to spot markets (contracting or vertical integration) these firms reduced risk and increased output, profits or both.

Blair's [1974] approach, utilizing uncertain prices and grower attitude towards risk, will be illustrated briefly. Blair argues that firms frequently do not know input and output prices in advance of their production decision. Thus, instead of each firm possessing a traditional profit function, each firm maximizes expected profits. Blair's traditional profit function can be written as

$$\pi = P(Q) \cdot Q - \sum_{i=1}^{n} x_i \, p_i \, (x_i)$$

where π denotes profit, $P(Q)$ is the inverse demand function for the firm's output, and $p_i\,(x_i)$ is the inverse input supply function for the i^{th} input. He uses inverse functions because he is assuming market power on the part of the firm. This assumption is not necessary for the analysis; it could assume a perfect competitor. He introduces uncertainty in the following fashion:

$$\text{Max } E \{ U[P(Q) \cdot Q - \sum_{i=1}^{n} x_i p_i (x_i, u_i)] \}$$

where the firm now maximizes the expected utility of profit, and E denotes expectation and U is a von Neumann-Morganstern utility index, and the realized price of the i^{th} input contains the random element, u_i. Blair [1974] later argues that one way of measuring the firm's risk aversion is to measure the maximum amount the firm would be willing to give up in expected profits to achieve a certain level of profit. He concludes that differing buyer and seller assessments of risk can cause contracts to disappear from markets where they had prevailed. He also argues that this may be one reason why observed contract prices are frequently below comparable spot market prices.

Carlton [1979b] also concludes that risk reduction causes contract prices to fall below spot market prices. His arguments are based on costs of production, however, rather than firm manager's attitude towards risk. "Long-term contracts are a mechanism by which a firm can reduce the costs of operating in an uncertain environment . . . . I am not assuming that firms dislike risk because of risk aversion. Rather, I am arguing that real costs are associated with operating in a variable market" [Carlton, 1979b, p. 1038]. Carlton postulates that if firms have U-shaped cost curves, "variability of quantity produced imposes costs on a firm that could be lowered if plants of appropriate flexibility could be redesigned far enough in advance" [1979, p. 1038]. He then constructs sample supply and demand functions for contracts, and shows conditions (higher spot market price variability) under which contract prices would be expected to be lower than spot market average price.

These studies were useful in general terms by demonstrating a possible firm incentive, and Carlton's study [1979b] was particularly useful in that it contained empirically-testable hypotheses.

Market Power

Several economists from the University of Chicago are prominent contributors to the demonstration of potential market power as an incentive for firms to forego use of existing spot markets. George Stigler [1951] was among the first to point out that change from market to nonmarket activity implies profit maximizing behavior. Investigations then began to explain why this might be true. Vernon and Graham [1971] demonstrated that a monopolist producing an intermediate product which was sold in a competitive situation would have a profit incentive to integrate forward if he did not have a fixed proportion production function. Schmalensee [1973] then expanded this analysis to include a monopolist who is prevented by threat of antitrust action from integrating to include all of the competitive firms downstream, and concludes there is still a profit incentive for the monopolist to partially integrate.

This type of analysis has been expanded to include a variety of other imperfect competition situations in which it can be demonstrated mathematically that through vergical integration, or tying, increased profits can be achieved. The above type of analysis was also extended to the monopsonist, and it was demonstrated that backward integration could also increase profits for imperfectly competitive buyers (i.e., monopsonists) [Perry, 1978a]. Perry also addressed an input monopolist integrating forward [1978b] whereby he showed an incentive to integrate

into all firms except the one with the most inelastic derived demand curve.

J. R. Gould [1977] expanded the scope of imperfect competition incentives for firms to forego use of spot markets by demonstrating that it is possible for monopolists to exploit factors employed by, and the customers of, a monopolist's customers. Burstein [1960] and then Blair and Kaserman [1978] demonstrated mathematically that a monopolist could achieve identical results through tying as with actual vertical integration. The Blair and Kaserman article also addressed the anti-trust implications of this finding, because there had been no activity prohibiting tying, whereas the potentials from vertical integration were recognized by the Federal Trade Commission at that time.

Finally, I. M. Greenhut and H. Ohta [1979] have demonstrated mathematically that there are a variety of market conditions under which vertical integration of successive oligopolists is mutually profitable. They also found that in such cases, industry output would be lowered.

As with virtually all of the literature concerning selection of vertical exchange mechanisms in imperfect market conditions, the above set of articles centered around vertical integration as the only alternative considered. Also, as with articles about other types of incentives for firms to forego use of existing spot markets, this group of articles did not address different firm selections and was not empirical in nature.

To summarize this section, then, it was recognized at the beginning of this Chapter that in order to evaluate market pricing performance among alternate vertical exchange mechanisms, it is first necessary to be able to isolate the factors which cause firms to select one mechanism

over the others, in order to evaluate benefits and costs among the alternate mechanisms. Accordingly, this Chapter began with a review of relevant literature concerning incentives for firms to choose alternate vertical exchange mechanisms. These incentives were grouped into four general categories: transaction costs, technology, risk reduction and market power. Within each general category, articles pertaining to the issue at hand were reviewed. From this review several observations are possible. Virtually all of these articles have treated only one factor (incentive) in their discussion, ignoring the possible interaction among different factors (incentives) which might influence firms in an empirical setting. Also, these articles are almost totally theoretical in nature, and many do not provide implications which suggest empirical application.

This should not be construed to imply that all work pertaining to firm selection of vertical exchange mechanisms falls neatly into one of the categories of incentives just described. The next section will review different types of analyses which have been utilized to examine one or more of the categories of incentives previously presented. This next section will be sub-divided by types of approach utilized. Three different techniques will be discussed.

Approaches for Analysis of Firm Selection of Vertical Exchange Mechanisms

Descriptive Industry Studies

There are many significant and useful projects in which the authors have not presented hypotheses as to why firms have changed use of vertical exchange mechanisms from predominantly spot markets to

contracting and/or vertical integration, but have described changes which they have observed within these industries over time. In these studies, market changes and characteristics are enumerated when firms change patronage from one vertical exchange mechanism (spot markets) to another (contracting). Hypotheses for the causes of these changes are presented in some cases, but few empirical test results are provided.

One of the most comprehensive descriptions of use of alternate vertical exchange mechanisms is by Marion and Arthur [1973]. This research bulletin describes the historical sequence of events which led to the high level of contracting and vertical integration within the Maryland broiler industry. Factors such as technology, price and supply conditions, changes in institutions and government policy, and changes in firm goals and methods of achieving these goals were suggested as factors contributing to changes in use of exchange mechanisms in this industry over time. Although the study did not present or test any of the factors they considered to be significant, their informed observations lend weight to the theoretical body of literature (previously reviewed) which suggests that these factors Marion and Arthur observed as significant have a theoretical basis for their inclusion in discussions of firm selection of vertical exchange mechanisms.

Since the Marion and Arthur study, numerous studies, particularly in conjunction with NC Project 117, have been conducted or have begun in order to assess factors in numerous industries which have led to different uses of alternate vertical exchange mechanisms. A Comparative Analysis of Factors Affecting Changes in the Structure of the Cattle Feeding, Broiler, and Processing Vegetable Production Subsector [USDA, 1976] attempts to identify characteristics which these different

industries have in common, hypothesizing that the same factors cause firms in different industries to adopt non-market exchange mechanisms. Such factors as shifts in location of production, concentration of production, mechanical and biological changes in technology, pecuniary economies, risk and information systems were listed and evaluated by the authors on the basis of their familiarity with these systems; no econometric model was formulated or tested. This study made two primary contributions to the present analysis. First, it represents another independent effort to isolate empirical factors which have contributed to changing patronage of firms among alternate vertical exchange mechanisms, and is, therefore, a source of ideas for factors to consider in construction of an empirical model for a specific industry. Second, it supports the thesis that there are four general categories of incentives into which all specific factors may be classified. All factors presented in this study can be included in one or more of the categories previously presented.

Another descriptive study [Hayenga and Schrader, 1979] examined beef, pork, cheese, turkey and egg markets to compare similarities and differences in formula pricing among these commodities. Unlike the previous studies, this project evaluated only one category of incentive: transaction costs. The authors argued that formula pricing was one method (at least in theory) whereby transaction costs could be reduced virtually to zero. They, therefore, surveyed participants in these industries, soliciting participants' opinions as to how well formula pricing was working within their industry. They found opinions within each industry to be more or less in agreement, but among the different industries there was no agreement that formula pricing was good (or bad).

The beef and pork industries reported the greatest dissatisfactions and also reported the lowest percentage use of formula pricing. The authors then related these factors to the issue of "thin markets" and concluded that "In the commodity subsector analyzed, formula pricing has been a contributing factor, if not the primary factor, causing some negotiated markets to be thinly traded . . . " [Hayenga and Schrader, 1979, p. 17]. The authors then hazarded some opinions concerning the causes of these differences, citing different degrees of risk, geographic concentration and number of participants.

James Rhodes [1979] examined the beef, egg and sugar markets. He was primarily interested in pricing policies and problems in these markets and reported on the legislative and legal problems faced within the sugar and beef industries. Again, the issue was "thin markets" and the concern was with the reliability of reported spot market prices. The sugar industry appeared to have fewer problems than beef, but the CFTC (Commodity Futures Trading Commission) and Justice Department had expressed some concern about reported spot market prices, and their effects on futures trading in sugar. "Actual spot transactions were infrequent--about once every 10 days. A committee issued daily price quotations based on its judgment of the market. The possibilities of committee manipulation seemed apparent, but no evidence of inaccurate or improper price quotations was found by the CFTC " [Rhodes, 1979, p. 1-2]. In contrast, the beef subsector experienced serious legal and legislative concerns about its reported spot market prices, "yellow sheets." Rhodes described the nature of the investigation into the reporting of beef prices, but did not suggest factors which accounted for the difference in pricing performance between these two "thin markets." This

study again focused on the need to be able to explain why firms choose different vertical exchange mechanisms, and highlighted the fact that no organized approach to the problem has yet been presented.

There are also numerous generalized conceptual discussions of selection of alternate vertical exchange mechanisms which highlight these same needs and problems. Bruce Marion [1976] suggested that motives and consequences of firm selection might be closely aligned, so that looking at physical factors such as technical changes or government policy changes would be an appropriate approach for evaluating firms' selection of vergical exchange mechanisms. Several general hypotheses were presented, such as "Technical efficiency in multi-stage segments of sub-sectors increases as the linkages between these stages approach vertical integration" [Marion, 1976, p. 191]. He did not form any conclusions, but suggested that there are three "conceptual approaches to vertical organization and coordination analysis: technological determinism, behavioral and market structure" [Marion, 1976, pp. 185-186]. These general approaches were rejected in favor of the present structure of analysis because they were very diffused and loosely-defined as to their boundaries.

In conclusion, this body of literature contributed ideas for sources of variables to select in empirical model construction. It gave credence to the "four categories of incentives" as a means of organizing variables to select factors which have influenced firm selection of vertical exchange mechanisms within a given industry. It also suggested specific factors which might be considered in an empirical analysis, and demonstrated that these factors were included in the general categories of incentives. Finally, recognition should be given to Helmberger

et al. who proposed these categories.

> Several authors have discussed the incentives for vertical coordination. Such lists can be reduced to four general incentives: technological changes or complementarity, imperfect markets in adjacent states, and desire to reduce risk, and the desire to reduce transactions costs. [1980, p.212]

Simulations

Two significant simulation studies have been performed in which either actual, observed market conditions are quantified [Yuen, 1978] or in which possible market conditions are established and then through computer simulation techniques the behavior of this simulation market is observed, given specific changes in factors such as technology, market consideration, and the distribution of firms' use of existing alternate exchange mechanisms [Kilmer and Ward, 1979].

Yuen [1978] did not present conclusions in her paper, but in setting up an input-output simulation system to analyze the vegetable processing subsector she organized her hypotheses and conclusions around four characteristics of the industry: operational efficiency, coordinative effectiveness, price competitiveness and the pattern of income equity among participants. In defining these characteristics she, too, unknowingly supported the previously defined categories and selected variables which other authors have suggested as being significant factors in influencing firm's selection of vertical coordination mechanisms in other industries. She also noted the complexity of factors, suggesting that several interdependent factors work in concert to influence firms' decisions. Finally, she constructed a means of evaluating industry performance by utilizing competitive norms and measuring the deviations of observed behavior from that which would be

produced in a perfectly competitive situation, through use of the computer simulation. The quantifiability of this model, and its empirical uses, present a significant step forward in analysis of firm selection of vertical exchange mechanisms and the effect of these decisions on industry performance. Unfortunately, there are no empirical results from this study as yet.

Perhaps the most relevant (in terms of the present study) and comprehensive demonstration of firm's selection of vertical exchange mechanisms and its performance consequences is by Kilmer and Ward [1980]. This study also utilized computer simulation techniques to examine simultaneously the effects of risk, transaction costs, and technology on firm output characteristics and selection of vertical exchange mechanisms. The authors concluded that the differential effects of contracting, vertical integration and spot exchange on exchange performance result from differences caused by each coordinating device on (1) the quality of product delivered to buyers, (2) the technology used by sellers and (3) the cost of improved marketing plus the cost of negotiating or administering an exchange. They found that exchange performance varied with the use of vertical integration, contracting or use of spot markets under the above conditions. Prices, total industry output and economic rent varied depending on the coordination device utilized also. This resulted in a total industry output and total industry welfare that varied, depending on the percentage of firms utilizing each vertical exchange mechanism.

The Kilmer and Ward study contributed significantly to the present analysis in that it shared the same orientation of simultaneously considering more than one of the categories of incentives for firms to

forego use of existing spot markets; it showed the effects of different vertical exchange mechanisms through the production function of the firm, and demonstrated that there is an interaction between firms and industry whereby the performance of firms cause changes in industry performance, which affected the performance of firms.

Empirical Applications

Empirical tests of theoretical developments which explain firm use of alternate vertical exchange mechanisms and how they affect prices are conspicuously scarce. Hayenga and Schrader [1979] attempt to relate use of different vertical exchange mechanisms with specific industry characteristics. There was no statistical model tested within this study. However, it contained an empirical application in that the authors attempted to delineate the characteristics within each industry which promoted or hindered price information from being transmitted readily throughout the industry. Their conclusions were based on a survey of industry participants, and it was their final opinion that some of the sub-sectors they analyzed had better pricing performance.

William Lesser [1980] recently completed a study of the performance of the Great Lakes Yellow Perch industry. In this study the author attempted to analyze pricing performance by examining the adjustment time necessary to bring price into line with quantity when the area catch was either too light or too prolific. He concluded that informal contracts were the predominant vertical exchange mechanism within this industry, and that they provided the best means of market adjustment to supply fluctuations. There was some question concerning equity of returns, however.

> Although these agreements provide important coordinating functions, they do have the potential of reducing factor mobility and interfering with the efficiency of the market . . . . As a result, there are strong indications but insufficient empirical documentation that the producers are receiving sub-competitive prices. [Lesser, 1980, p. 24]

The study does not concentrate so much on the factors which influence firms to choose one type of vertical exchange mechanisms as it examines the consequences of this selection. However, it did develop a framework for empirical evaluation in measuring the time lags in adjustment to supply variations. In this regard it is a valuable contribution to vertical exchange mechanism literature.

One more article will be reviewed in this section. It consisted of an analysis of price differences in contracts for specific vegetable commodities in the northeast section of the U.S. [Jesse and Johnson, 1970]. Through regression analysis, the authors were able to demonstrate that different contract specifications resulted in different negotiated contract prices. Their conclusion was that contract prices without special features were approximately equal (competitively priced) and that contract provisions accounted for a large part of observed differences in contract prices. They recommended that farmers should not look at just the price of the contract in selecting a processor with whom to contract, but should also evaluate the other conditions and specifications within the contract.

The study began with the observation that contract prices for green peas and sweet corn differed among processors. The authors hypothesized that these different prices might not represent market imperfections, but reflect competitive solutions whereby differences within the contract specifications caused the differences in prices

offered. Factors common to both peas and sweet corn which they examined were: "seed charge, harvest charge, tare, passed acreage, date of payment, insecticide application, and yield bonus" [Jesse and Johnson, 1970, p. 547]. For peas alone they included "herbicide application, net return guarantee, field size bonus, and late planting bonus; for sweet corn, early planting bonus and high moisture bonus" [Jesse and Johnson, 1970, p. 547]. These factors were not selected on a theoretical basis, but as the observed differences in contract specifications. It seems evident from these specifications that there was a measureable amount of coordination and cooperation between growers and processors, and that these contract details represented a significant service for both growers and processors. Although the study made a significant contribution to the understanding of factors which affect contract price, the analysis was not predicted upon theorized reasons for the different specifications, and no hypotheses were presented to explain these observed differences or why firms chose one contract over another.

Conclusion

This chapter provided an overview of the literature concerning the incentives for firms to select among available vertical exchange mechanisms, and the consequences of their selection. It seems clear from the review that there is no current, comprehensive school of thought regarding either the theoretical basis for analysis of differences in price among contracts or between contracts and spot markets. Neither is there a coherent framework within which to analyze and explain firm selection of alternate vertical exchange mechanisms. Many specific incentives have been investigated individually in

theoretical settings, but none of these theoretical analyses have considered all incentives simultaneously, and conspicuously lacking are empirical, econometric analyses based on such a theoretical framework.

In developing theories, it is often fruitful or even necessary to make simplifying assumptions about all aspects of a market environment except the factor under examination in order to draw meaningful conclusions. In empirical analysis, however, all factors relevant to the firm's decision should be considered. Thus, a theoretical framework must be developed for examination of all relevant factors in concert. The preceding review of relevant literature was useful in that regard, also. It provided several different approaches for analysis, varying from purely theoretical development to empirical, econometric techniques. The literature review has also provided a general theoretical framework within which to look for relevant factors which determine firms' selection of vertical exchange mechanisms: transaction costs, technology, risk reduction and market power. Finally, this review has illustrated the appropriateness of development of a theoretical framework within which these various incentives are related to the firm's decision-making framework, and the need for a method of interpreting such behavior and its consequences at the market level.

Chapter III will present a theoretical framework within which firm selection of contracts or spot market useage can be explained, and this observed behavior is related to implicit prices associated with services available through each vertical exchange mechanism. Thus, differences in contract prices are explained, and differences between contracts and spot markets are also explained. This theoretical development is then tested in Chapters IV and V.

CHAPTER III
FIRM SELECTION OF VERTICAL EXCHANGE MECHANISMS AND MARKET PRICES

Introduction

It was observed in the preceding chapter that although the literature is rich with theoretical and empirical analyses of specific incentives for firms to use alternate vertical exchange mechanisms, there is no theoretical development which utilizes more than one of these incentives in the firm's decision-making framework. Consideration of any one specific factor yields insight into how the firm makes its decision to use contracting instead of the spot market, for example, but ignores (assumes they are held constant) all other variables while analyzing the effects of that one incentive. This chapter contains the development of a theoretical framework within which the "four categories of incentives" suggested by Helmberger et al. [1980] (risk, transaction costs, technology and market power) are all shown to have a potential influence upon firm selection of vertical exchange mechanisms. It is also shown how variables contained within these categories can influence prices observed between contracts and spot markets.

A conceptual approach will be developed for evaluating these different incentives. Then observed market prices will be related to these variables, and finally the firm's selection criterion will be demonstrated for contract specifications. Appendix A contains a discussion of the firm under conditions of risk and uncertainty, and illustrates

how the precedure developed in this chapter can be expanded to n variables.

The basis for this development rests upon enlargement of the traditional production function of the firm in which the only inputs are the physical inputs of production and the output is the simple agricultural product. This analysis begins with the recognition that the firm must also be aware of and include in its evaluation the expected costs and/or benefits associated with the vertical exchange mechanisms available for it to select. It will be argued that there is a collective set of factors associated with the use of any vertical exchange mechanism. These factors can affect the firm's output decision through observed price as well as determining the vertical exchange mechanism selected.

These collective factors will be called "services" and are associated with each available vertical exchange mechanism. For example, the set of services available from utilizing a spot market may differ from those available through contracting. Furthermore, there will be different service factors of interest to the buyer than are of direct concern to the seller.

These services are inextricably associated with the buying or selling of the physical product. Because of this association, it will be considered that buyer and seller are concerned with a product consisting of the physical good, and the collective factors associated with the vertical exchange mechanism (services). Thus, there would be a different product among spot markets, contracts and vertical integration, even though the physical good being exchanged was identical among all three vertical exchange mechanisms. It will be argued that it is the differences among services which determine by which vertical exchange

mechanism the buyer and seller will be brought together. In other words, the physical good is perfectly homogeneous among all vertical exchange mechanisms. It will be henceforth called the "base good." The services associated with these mechanisms differ, however, and it is these differences which produce different products from each vertical exchange mechanism and different associated prices.

Services as an Economic Commodity

Before all relevant factors influencing firm selection of vertical exchange mechanisms can be examined, there must be some context within which they can be classified. Considering these factors as services, or a package of services associated with each vertical exchange mechanism, is one way of examining them aggregatively. Each factor remains separate, but their effect is collective, and all can be considered in the context of the firm's decision to use one of the available vertical exchange mechanisms. It must be remembered, however, that this economic commodity (services) is an integral part of the actual product changing hands (base good). One way of defining "package of services" more explicitly is to first define the "base good." The agricultural good itself is the base good. It is perfectly homogeneous, with no special characteristics of any kind except some composite quality based on industry averages. No services would be attached to it (such as grading, transportation, etc.) and no specific characteristics as might be arranged in a forward contract.

Each specific action on the part of those handling the agricultural good would then become part of the "package of services" to be examined in this study. Two different types of services will be isolated:

services provided by third parties in the exchange process and services exchanged directly between buyer and seller. The following definitions will be used throughout this analysis:

1. Base Good: The physical product, which is homogeneous among coordinating mechanisms (i.e., does not possess time or place utility, and has no special characteristics of any kind such as quality, coordination, etc.).

2. Services: Any specific action on the part of those handling the exchange of the agricultural good pertaining to imparting special quality, information, or use characteristics to it.

3. Marketing Services: Those specific service factors associated with third parties in the exchange process (such as market commissions, legal fees, etc.).

4. Exchange Services: Specific service factors arranged directly between seller and buyer, such as quality premiums, delivery specifications, technical advice, financial aid, or reduction of price risk, as negotiated in a written contract.

There is a third type of service, information and regulatory service, which may be provided by public agencies. Since neither party pays directly for these services and they are available equally to all participants, they will be considered a type of public good and not given specific consideration in this study. These public goods may affect both price and quantity of output, but determination of their effects upon individual firms is difficult to isolate empirically, since the price would be zero.

These different types of services will be illustrated by the vertical marketing link analyzed empirically in this study: growers (sellers) and processors or brokers (buyers) of potatoes for potato chips in the Hastings, Florida, area. Marketing services are relatively easy to isolate. They can be observed as functions performed by third parties which affect the exchange process. Exchange services differ

only in that no third party is involved in supplying them. The service factors are identical (such as price risk reduction) but are considered to be market services if they are supplied by others and exchange services if they are supplied by one of the exchanging parties. The significance of this distinction is the recognition that these services are still provided, although they are embedded within exchange of the base good. Once recognition is given to their existence, it gives rise to the suggestion of measuring their price and quantity during exchange. This will be the basis for price analysis in the present study which is relating services of all kinds to their implicit prices in the exchange of physical good, either through contracting or spot market exchanges.

When examining exchange services, it must be considered that the grower could supply services to the processor and also demand services which are supplied by the processor. Each may be simultaneously supplying and demanding different services from one another. These factors should affect contract price oppositely. Services which the grower demands should decrease the contract price; services which the processor demands should increase contract price.

Classification of these service factors has already been discussed. Each service factor is included in one of the "four categories of incentives" presented earlier. This categorization is useful in organizing and interpreting effects of each service factor. How these service factors affect observed exchange price will be developed next, and then it will be shown how the seller and buyer evaluate service factors through the effects on their objective function. Finally, a method of relating services to observed exchange price will be presented.

Components of Observed Price

Only one price is observed in the exchange of the product between grower and processor. Separate prices for the base good and for each service factor included in the exchange are not observed. It is suggested here that each service factor does affect the observed price and, therefore, the exchange price is determined by the summation of each implicit service price times its level of service, plus the base good price. Equation (1) illustrates this relationship.

$$(1) \quad P_{EX_i} = P_B + \sum_{j=1}^{r} P_{se_{i,j}} \alpha_j + \sum_{k=1}^{h} P_{m_{i,k}} \theta_k$$

where P_{EX_i} is the observed exchange price on a per-unit basis in each vertical exchange mechanism (spot market or contracting); P_B is the base good price on a per-unit basis (It has no subscript because it is identical among all vertical exchange mechanisms.); $\Sigma P_{se_{i,j}} \alpha_j$ is the weighted sum of all exchange service payments in the i^{th} vertical exchange mechanism (For example, if se_1 is a 0-1 variable, its value is simply zero or P_{se_1}, whereas if it is a continuous variable, its value is P_{se_1} times the level of that service offered.); and $\Sigma P_{m_{i,k}} \theta_k$ is the weighted summation of all marketing service payments in the i^{th} vertical exchange mechanism on a per-unit basis. Services which are demanded by the seller will have a negative effect on price, but services which are demanded by the buyer will have a positive effect on the observed exchange price. This conclusion is intuitive. For the seller to "pay for" services he desires, he would "pay" by accepting a lower exchange price; the buyer would pay for these services directly, which would increase the exchange price.

Equation (1) implies a separate price for each service supplied and demanded in a transaction. These individual prices are not empirically observed, except as market commissions and transportation charges, etc., are directly observed. Yet, if these service factors have value to either party, it is reasonable to expect that indirect payments are made to these factors. These payments will be called "implicit prices," as in hedonic price analysis. Each service factor represents risk reduction payment, a transaction cost, a technology-induced saving, or price influence because of market power by one of the parties. These factors are each paid a price implicitly, and through a hedonic price analysis, these implicit prices can be measured. A brief discussion of hedonics is, therefore, appropriate at this juncture.

Hedonics

Equation (1) suggests that one manner in which observed price can be analyzed is to relate implicit service prices to observed exchange price. This approach is basically what is entailed in hedonics. It has been described as "the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them." [Rosen, 1974, p. 34] Hedonics has traditionally dealt with consumer items in explaining observed differences in price among similar products, based on different features of each. For example, hedonics has been used to value "extra features" on automobiles [Fisher et al., 1962] or the value of job or locational characteristics [Kenny and Denslow, 1980].

Traditionally, hedonics has dealt with a group of similar but differentiated products. Prices for these related products are close but

not identical in the marketplace. One manner in which these observed differences in price can be explained is to suggest that there are differences either in physical specifications or in consumer perception among these similar products, and that payment for these differing characteristics accounts for the differences in price. A car with white-wall tires may provide more utility to customers, making them willing to pay more for an automobile with this feature. As long as their willingness to pay is equal to or greater than the cost to the manufacturer of providing these features, then some cars will offer these specifications, and the difference in price between a car with white-wall tires and a car identical in all other respects with regular tires represents the implicit price of white-wall tires on a car. Rosen [1974] defines a "plane" of several dimensions representing different combinations and levels of characteristics. Both sellers and buyers locate at different points on this plane, which he labels as $p(z)$ where z is a line-vector of consumer goods characteristics of a group of differentiated products and $p(z)$ represents the set of observed exchange prices. He then sets up some market clearing conditions for exchange between seller and buyer:

> Amounts of commodities offered by sellers at every point on the plane must equal amounts demanded by consumers choosing to locate there. Both consumers and producers base their locational and quantity decisions on maximizing behavior, and equilibrium prices are determined so that buyers and sellers are perfectly matched. [Rosen, 1974, p. 35]

The next section demonstrates how the principles of hedonics can be applied to analysis of contract prices and provisions.

Hedonic Analysis of Contracts

Although hedonics is usually applied at the consumer goods level, there is no reason to reject its use in a firm level analysis. The keys to this type of analysis require that a differentiated product be examined in a sufficiently large cross-section to reveal differences in specification and price among the products.

If the contracting mechanism contains different specifications or characteristics, it will be assumed that the contracts each represent a differentiated product. Therefore, as each party evaluates each available service in determining his optimal contract (for given prices) then he is considered to be evaluating differentiated products.

For illustrative purposes, determining the level of quality (an uncertainty factor) will be considered. Let the grower of potatoes for potato chips have the option of utilizing different levels of fertilizer application in producing different levels of quality in his potatoes. This improved quality would be an exchange service factor if the grower and processor agreed upon a given level of quality in advance as a written contract specification. The grower's production function would then consist of the joint output of base good, B, and exchange service of quality, se_q; his only variable input would be fertilizer, x. This is shown in Equation (2).

$$(2) \quad B, se_q = f(x)$$

where the variables are as defined. Assuming that prices are competitively determined by the market, the grower's profit function would be in the form of Equation (3).

$$(3) \quad \pi = P_B B + B(P_{se_q} se_q) - P_X X$$

where B is the base good quantity, se_q is the level of the exchange service of quality and x is the only variable input, fertilizer. The middle term shows the number of units (B) of output produced of quality level se_q. Since x is used to produce both B and se_q, it can be considered a joint output. Thus, $x = g(B,se_q)$ and this can be substituted into the profit function for x. Equation (4) shows this, and Equations (5) and (6) show first order conditions to determine optimality.

$$(4) \quad \pi = P_B B + P_{se_q} se_q - P_X g(B,se_q).$$

$$(5) \quad \frac{\partial \pi}{\partial B} = P_B - P_X g'(B,se_q) = 0.$$

$$(6) \quad \frac{\partial \pi}{\partial se_q} = P_{se_q} - P_X g'(B,se_q) = 0.$$

Rearranging terms and solving for P_B and P_{se_q} will illustrate the grower's supply curves for each part of the joint product. Marginal cost of producing each part of output will be equated with its price. Once this optimal level of output (B) has been determined, it will be fixed (for illustrative purposes only) at B^*. Assuming that the grower is in Region II of production where the marginal product of fertilizer is decreasing and that profit is set at the competitive level determined by Equations (4) thru (6), then an iso-profit curve can be drawn. Figure 1 illustrates one such iso-profit curve for the grower producing

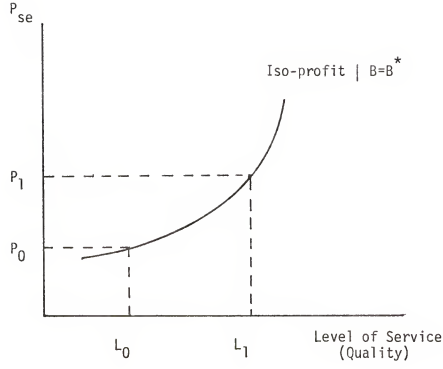

Figure 1. Sample iso-profit curve for seller of exchange service of quality

different levels of quality when profit and quantity of base good are fixed. Different levels of quality correspond to different output prices. P_1 is greater than P_0 because the level of quality is greater at L_1. Since it is assumed that the marginal product of the input is decreasing, in order to maintain a constant profit level the grower would have to receive an increasingly larger price for higher levels of quality (the exchange service output). Thus, the iso-profit curve is increasing at an increasing rate.

In order for exchange to occur, a buyer must be willing to purchase the joint product of base good plus the exchange service of quality at the level and price the grower is willing to produce. Thus, examination of the processor's derived demand for the joint product is necessary. The processor's production function is presented in Equation (7). The two variable inputs are B and se_q.

$$(7) \quad Y = f(B, se_q)$$

where Y is the processor's output of potato chips. If prices are competitively determined, the processor's profit function would be of the form of Equation (8).

$$(8) \quad \pi = P_Y f(B, se_q) - P_B B - P_{se_q} se_q$$

and solving first order conditions reveals the processor's derived demand for the base good and exchange service of quality, shown in Equations (9) through (12).

$$(9) \quad \frac{\partial \pi}{\partial B} = P_Y f'(B, se_q) - P_B = 0$$

$$(10)\quad \frac{\partial \pi}{\partial se_q} = P_Y\, f'(B, se_q) - P_{se_q} = 0$$

or rearranging terms,

$$(11)\quad P_Y\, f'(B, se_q) = P_B$$

$$(12)\quad P_Y\, f'(B, se_q) = P_{se_q}$$

which is a form of derived demand whereby marginal value product of each input is equated to its price. It will also be assumed that the processor is in Region II of production so that the marginal product of each input is decreasing. If the quantity of base good, B, is fixed at the optimal level, B^*, Figure 2 shows an iso-profit curve for the processor when profit is fixed at the competitive level determined by Equations (11) and (12). The iso-profit curve increases at a decreasing rate because the marginal product of se_q is decreasing. In order to keep profit at the set level, the processor must pay increasingly less for each additional unit of quality because it adds less to total revenue. P_1 exceeds P_0 because the level of quality at L_1 exceeds the level of quality at L_0.

If grower and processor successfully negotiate a contract, then these two surfaces (iso-profit curves) must be tangent to one another at some point. And at that point, the level of service and its price will be mutually determined. One such equilibrium point is depicted in Figure 3. This represents one point on what Rosen [1974] calls the "hedonic plane." Figure 4 illustrates one hedonic plane which shows two different grower locations, representing different observed prices based

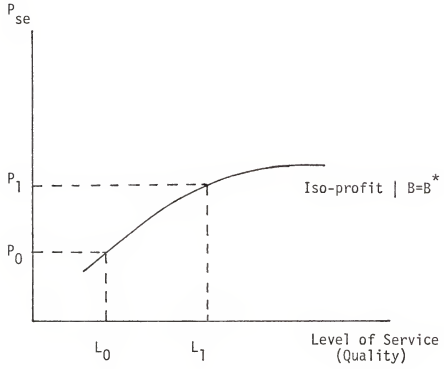

Figure 2. Sample iso-profit curve for buyer of exchange service of quality

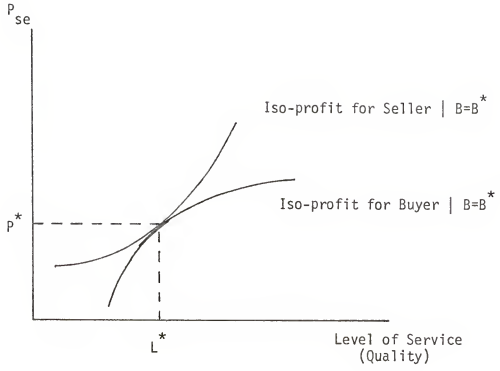

Figure 3. Equilibrium price and quantity of exchange service of quality

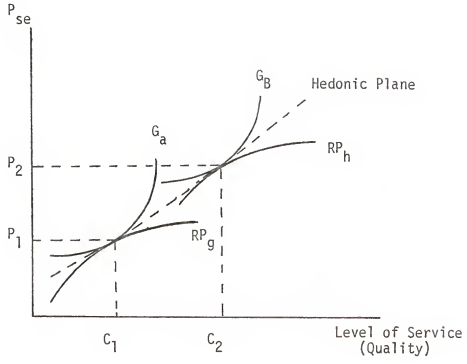

Figure 4. Sample hedonic plane representing different observed contracts prices based on different levels of service exchanged

on different levels of the exchange service of quality arranged between two different growers and processors.

Appendix A contains a mathematical development of this analysis when n services are considered. The key to the equilibrium condition lies in the marginal cost to seller equaling the marginal benefit to buyer. This would be true for each service factor, and the overall contract negotiated. Each market participant evaluates the implicit price of all service factors available through different contracts, and selects the specifications and levels of service which are optimal. Solution of market clearing conditions for all service characteristics levels would produce a hedonic surface in which equilibrium points of exchange are traced out for different levels of services and different service factors exchanged. Differences in cost curves produce different points of tangency on the hedonic surface representing different service combinations and different levels of each service exchanged.

Clearly, all firms will not meet at the same equilibrium point unless they have identical production functions, and identical attitudes toward risk. Otherwise, different firms with different characteristics will represent different observed exchange points. The several different points of equilibrium between buyers and sellers exchanging different levels of the service of quality map out the implicit price surface. These differences account for differences in observed exchange price among contracts, and a cross-section regression analysis of contracts with different service specifications provides estimates of the implicit prices for these services.

This can explain why some firms choose contracting and others use the spot market. Differences in firm production functions account for

differences in equilibrium points. Firms evaluate the aggregate characteristics and their implicit prices of all available vertical exchange mechanisms and select that one which maximizes the value of their objective function.

Hedonic Analysis of Spot Market

A hedonic price analysis could be conducted upon a spot market to measure the implicit service prices of factors from the same "four categories of incentives" of risk reduction, transaction costs, market power and technology. If these service factors vary across local markets, their implicit prices can be estimated by comparing data pertaining to each market. If services have changed over time, a time-series analysis could be used to estimate implicit prices of those services which have changed.

Summary

This chapter began with the suggestion that services are associated with different vertical exchange mechanisms. The physical agricultural product independent of these services was called the base good, and services were categorized as marketing services, exchange services or regulatory services. Each factor could be classified as one of the "four categories of incentives" of risk reduction, market power, technology or transaction costs. It was suggested that implicit prices were associated with these services, and it was demonstrated how growers and processors (as sellers and buyers) incorporated these factors into their respective objective functions.

Risk was explicitly considered as an incentive for firms to select alternate vertical exchange mechanisms in Appendix A. It also illustrated how the procedure developed in this chapter could be expanded to n-variables. Elements of the other categories of incentives, transaction costs, market power and technology, could be incorporated as variables in a straightforward manner as shown in Appendix A.

Finally, the principles of hedonic price analysis were applied to the problem of estimating implicit service prices and it was shown how different firms would meet at different optimal levels of services and different prices, based on their different objective functions. Solution of first order conditions of characteristics and prices of services in each vertical exchange mechanism also led to firm selection of alternate vertical exchange mechanisms.

Conclusions

There are different services associated with different vertical exchange mechanisms. These different services affect the observed price in each vertical exchange mechanism through implicit service prices. Thus, estimating the implicit service price of each service associated with different vertical exchange mechanisms can explain prices within each mechanism and between mechanisms.

The recognition of different services can also explain differences in firm selection of vertical exchange mechanisms. If different firms within an industry all have identcal production functions, all should choose the same vertical exchange mechanism. If firms possess identical production functions and choose different vertical exchange mechanisms, it is an indication of market problems within that industry. However,

if different firms possess different production functions, through solution of first order conditions (as demonstrated in this chapter and in Appendix A) firms could find different vertical exchange mechanisms to represent an optimal solution.

In conclusion, in order to explain prices in different vertical exchange mechanisms and why firms select different mechanisms, an analysis of both firm production functions and an analysis of service prices in different vertical exchange mechanisms is necessary.

Chapter IV presents the mathematical models developed from these principles in examination of the Hastings, Florida, chip potato market.

CHAPTER IV
EMPIRICAL MODELS

Introduction

It was suggested in Chapter III that differences in price among contracts could be explained by differences in services, and a hedonic price analysis could be used to estimate the implicit prices of these services. It was also suggested that this technique could be used to explain spot market prices. Spot prices might change over time in part because of changes in services offered. Also, spot and contract prices might differ because of differences in services. This chapter presents a test of these hypotheses.

Chapter III also suggested that firms include service factors associated with different vertical exchange mechanisms in evaluation of their objective function. Differences in firm cost curves explain why firms choose different specifications in contracts, and why some firms use the spot market and others contract. A test for differences in firm characteristics between spot market and contract use concludes the empirical evaluation of the theoretical development of Chapter III.

Selection of variables will be presented first, followed by a discussion of the data used in this study; econometric problems will then be analyzed, and the models estimated will be presented.

Variable Selection

Variables were classified by the "four categories of incentives" presented previously of risk reduction, market power, technology and transaction costs. Exogenous supply and demand factors were also included. Table 1 presents the variables used in each part of the analysis, and Table 2 defines each of these variables.

Contracting Variables

The theoretical development of Chapter III suggests that there are different service factors associated with different vertical exchange mechanisms, but that factors can be classified as risk reduction, market power, transaction costs or technology variables. There are four risk variables in the contract model. They are the percentage of the growers' expected output under contract (PFMCON), who determines when the potatoes are harvested (HVSAY), whether or not a quality level was specified (QUAL) and whether or not grower i received a production credit association loan (PCA) (see Tables 1 and 2).

Including a clause requiring a given level of quality is a means of reducing quality risk for the buyer. It may require additional costs for the grower, however, because some of his output may be rejected and he may have to use more inputs to produce the required level of quality. Therefore, this variable is hypothesized to have a positive effect on contract price.

PCA is a summary variable measuring several grower characteristics which may lead to quality risk reduction for the buyer. Production credit associations (PCA's) examine the overall firm picture of an

Table 1. Variables used in each part of the analysis

Category of incentive and exogenous shifters	Contract analysis	Spot market analysis	Firm characteristics
Dependent variable	DPR	DFSMP-DFCOM	DCON
Intercept	P_B (+)*	P_B (+)	γ_0
Risk reduction	QUAL (+)	SMACVA (+)	ACRE (+)
	PCA (+)	DFCMP (-)	FMAGE (-)
	HVSAY (+)		DPCA (+)
	PFMCON (+)		
Transaction costs	DELAY (+)	DFCOM	DGA (-)
Technology	VARSP (+)	DBLK (-)	ACRE (+)
	INFO (-)	TSHIP (+)	DPKHS (-)
Market power	---	---	DGA (-)
Exogenous shifters	D1	TRD (+)	---
	D2		
	D3		
	D4		
	D1 - D4		

* Signs in parentheses indicate expected sign for coefficient of variable, if an expectation is appropriate.

Table 2. Definition of variables used

Variable	Definition
DPR	Deflated price of contract c for grower i in year t.
QUAL	Qualitative variable equaling one if contract c specified a grade or quality level for potatoes.
PCA	Qualitative variable equaling one if grower i received a loan from a Production Credit Association (PCA).
PFMCON	Percentage of grower i's output contracted in year t.
HVSAY	Qualitative variable equaling one if grower i was given determination of harvest date for his potatoes in a contract for year t, -1 if buyer set harvest date.
DELAY	Number of days after harvest before grower i received payment for his potatoes contracted in year t.
INFO	Qualitative variable equaling one if grower i received technical advice through contracting in year t.
VARSP	Qualitative variable equaling one if grower i contracted to provide a specific variety of potato in year t.
D1	Qualitative variable equaling one in 1980, zero otherwise.
D2	Qualitative variable equaling one in 1979, zero otherwise.
D3	Qualitative variable equaling one in 1978, zero otherwise.

Table 2. Continued

Variable	Definition
D4	Qualitative variable equaling one in 1977, zero otherwise.
D1 - D4	Qualitative variables equaling minus one in 1976, zero or one otherwise as previously defined.
DFSMP	Deflated spot market price in year t.
SMACVA	Variance of the ratio of deflated spot price to deflated average cost of production in year t-1.
DFCMP	Deflated change in minimum spot market price $(P_{t-1}) - (P_{t-2})$.
DFCOM	Deflated broker's fee.
TSHIP	Proportion of Hastings, Florida, production shipped by truck in year t.
DBLK	Qualitative variable equal to one for years in which potatoes were shipped in bulk, zero if they were bagged (value is one if both).
TRD	Qualitative variable equal to one for 1950-1959 and 1976-1980, two otherwise.
DCON	Qualitative variable equaling one if grower i contracted, zero otherwise.
ACRE	Acreage in grower i's farm.
FMAGE	Number of years grower i has produced potatoes.
DPCA	Qualitative variable equaling one if grower i received a loan, zero otherwise.
DGA	Qualitative variable equaline one if grower i was a member of either the North Florida Grower's Exchange of the Hastings Potato Growers' Association.
DPKHS	Qualitative variable equaling one if grower i had a financial interest in a packinghouse.

applicant and make recommendations on production techniques and equipment use. This information should make the grower a more desirable producer from the point of view of producing a better quality of output. Also, the loan may represent investment in improved production equipment, etc., and may also represent a younger grower with more education and more recent knowledge of production techniques, all of which result in improved quality of output. This variable should thus have a positive effect on contract price.

PFMCON represents risk reduction for the buyer in that he is unsure of the price required to form a contract with another grower, and may find it to be less expensive to contract as great a proportion with known growers as possible. Increased proportion of grower's output being under contract would represent a risk reduction factor for the buyer if that particular seller possessed desirable capabilities from the buyer's perspective. For example, if the buyer knew that grower i was competent and reliable, then he might prefer to pay a slight premium to that grower to produce more of his output under contract than he would pay an unfamiliar grower for the same quantity.

Most growers do not contract for 100 percent of expected output because of uncertainties in spot market price and growing conditions which is PFMCON. If all output is committed through contracts and the spot market price is higher, then the grower is foregoing that potential profit. It has been historically true that frequently spot price exceeds contract price, so the grower would require a higher contract price in order to commit a greater proportion of his output to contracts. Also, since growers cannot predict the weather in advance, committing a greater proportion of their output in advance might force them to

purchase potatoes in order to satisfy their contractual obligations. Thus, this variable is expected to have a positive coefficient.

HVSAY represents a production risk. If the grower does not control when the potatoes are harvested, they may not be dug at peak yields, and he will lose revenue. However, if the buyer cannot set harvest, it may be more costly to coordinate transportation and chip plant operations. Thus, if the grower controls harvest, it should have a negative effect on price as a seller benefit, and if the buyer controls harvest, it will be of benefit to him and should have a positive effect on price. The variable was coded as a $\pm$ 1, however, so that its coefficient should be positive.

DELAY represents a transaction cost for the grower if he is not paid immediately for his potatoes upon harvest. This results in the grower "lending" money to the buyer, which is considered to be a transaction cost and is hypothesized to have a positive effect on contract price.

INFO and VARSP are variables associated with technology. There is little evidence of buyers offering extensive exchange of information or promoting technological changes on the part of growers, but some buyers did indicate they offer advice on varieties to plant, growing techniques, etc., and INFO represents an exchange of technical information. This represents a grower benefit and is expected to have a negative coefficient. The only other discernible technology factor is the change in the area of use of the Sebago variety potato for chips to the Atlantic variety. Thus, a 0-1 variable was included for whether or not the contract includes specification of variety. It was hypothesized that a premium would have to be offered the grower to use the variety specified

by the buyer because seed potatoes might cost more, there might be unknown problems in growing a new variety and other related factors might make the grower unwilling to use a new variety without compensation. Thus, this coefficient was hypothesized to carry a positive sign.

The qualitative variables, D1-D4 and QQ, are utilized to capture exogenous supply and demand changes which had an influence on price for each year estimated. These "dummy variables" represent the change in derived demand factors and primary supply factors which influence prices from year to year. It should be noted that they sum to zero, so that no year's effect is imbedded within the estimate of the intercept.

No variables for market power are included in the contract hedonic price analysis because there are many parties on both sides who could provide partners for individual contracts. There are over a dozen known buyers who contract in the area, and an estimated 60 growers. Concentration data could have been included, but individual buyers and sellers were for the most part too small to include.

Spot Market Variables

A different set of service factors were measured for the spot market than the contract analysis contained because there are different service factors associated with each vertical exchange mechanism. Variables can still be categorized by the "four categories of incentives," however, and will be presented and discussed on that basis. DFCMP and SMACVA are measures of risk. SMACVA is a measure of spot market cost/price variance. Since average costs are an important consideration for growers contemplating use of the spot market, it was decided to index variation to average costs. The calculation for this

variable in year t is provided in Equation (13)

$$(13) \quad SMACVA_t = \{(DFSMP_{t-1} / DFAC_{t-1}) - \overline{DFSMP} / \overline{DFAC})\}^2$$

where $DFSMP_{t-1}$ is deflated spot market price, $DFAC_{t-1}$ is deflated average production costs, $\overline{DFSMP}$ is the average real spot market price over the 31-year period and $\overline{DFAC}$ is the real average cost of production for the 31-year period. This variable is considered to be a grower service in that if the variance of the price/cost ratio decreases, the grower will feel more certain of what profit he should receive from the market. This would cause more growers to use the spot market if the variance decreases, and price will also decrease. Thus, this variable should have a positive coefficient, indicating that price and variance move in the same direction. Decreased variance is a grower benefit, however.

DFCMP is the deflated change in minimum spot market price from the previous two seasons. Fluctuations in spot market price represent a form of risk, and increased stability in spot market prices would represent a reduction in price risk for growers contemplating use of the spot market. A 2-year change was selected because growers using the market at the peak of harvest probably receive the market's minimum price and again, risk of bankruptcy makes growers sensitive to risk of low minimum prices, and two years of adverse prices might force them to contract the following year in order to be sure to receive enough money to cover production costs. The expected sign of this variable was negative because increases in the minimum spot market price from one year to the next would represent the service of reduced price risk to

growers, which would have a negative effect on average exchange price because more growers would be expected to use the spot market.

DBLK is a technology factor. During the 1970's it was discovered that potatoes did not have to be bagged to be transported. This change in shipping method was less expensive than bagging. Since it saved growers the cost of bagging, this variable is expected to have a negative coefficient, representing a change which benefitted growers.

TSHIP is a measure of percentage of area potatoes shipped by truck (as opposed to rail). Trucks are more convenient because they can be loaded anywhere and driven many places railroads don't go. This is hypothesized as a benefit to buyers and should, therefore, have a positive estimated coefficient.

There are no measures of market power in this model because of data limitations. There is no variable for buyer market power because there is no evidence of power and no history of court trials alleging collusion among buyers. There are or have been three growers bargaining associations in Hastings during the 31 years examined, but adequate data were not available to include any measure in the analysis.

The hedonic price analysis of the spot market was designed to estimate the implicit price of services which had changed in the market during the period of observation. All marketing services, such as transportation costs, commissions, etc., should have been subtracted from the dependent variables before estimation. Broker commissions were, therefore, subtracted from the value of the dependent variable, DFSMP, prior to estimation. This represents a transaction cost, but since its value was known, there was no need to estimate it. Also, since

all figures on spot market prices included payment for broker services, it was appropriate to exclude this payment.

TRD is a trend variable to account for changes in the performance of the market because of exogenous factors. Through interviews with market participants it was revealed that during the 1950's the market did not have a large volume of chip potatoes; it was primarily for table stock. It was during the period of 1960 through the early 1970's that the market was a vital force in the area. Population distribution caused demand for potato chips to increase, fast-food chains demanded potato chips, and storage of potatoes plus inexpensive transportation all lead to a "healthy" market. It is felt that after the change in energy prices in 1973, and because of changes in potato storage at that time plus changes in chip technology, demand for potatoes from the Hastings market has again declined. Since these factors are not market or exchange services, yet affected observed price, they were qualitatively included as a trend variable for each different period of the market.

Grower Characteristics

The theoretical development of Chapter III suggested that given the value of implicit services, growers would compare expected profits from use of each vertical exchange mechanism and select the optimal. The question must then be asked: Why do different firms choose different vertical exchange mechanisms? If all firms pay and receive the same price for each service factor in each vertical exchange mechanism, why don't all firms use the same vertical exchange mechanism? Is it an

indication of some type of market failure for patronage of one vertical exchange mechanism to decline in favor of another?

The theoretical framework of Chapter III provided a different explanation for these occurrences. If firms possess different production functions, or if the production function is changing over time, this can explain the selection of different vertical exchange mechanisms. A model was, therefore, constructed to test for firm differences among firms which chose contracting versus the spot market. Again, these factors were categorized by the "four categories of incentives" utilized previously.

ACRE includes elements of risk and transaction costs. Larger farms may feel less inclined to use the spot market because of the magnitude of potential loss from adverse prices. Also, larger farms are expected to be more inclined to contract because there may be a fixed cost associated with negotiating a contract, and this would translate into a smaller average cost for a larger grower.

FMAGE is a factor associated with ability to deal with risk, and this factor is hypothesized to be negatively related to contracting. Growers with more experience may be more able to deal with changing environmental conditions. They should know more about what to expect from their land, and behavior of the spot market and, therefore, more willing to use the spot market. (See T. W. Schultz [1975] for a discussion of the relationship between experience and ability to deal with uncertainty.)

DPCA relates to whether or not a grower received a loan from a PCA (Production Credit Association) or other lending agency. It is hypothesized that this characteristic will be positively related to contracting

because lending agencies may judge that a loan is more fully secured if the grower has a contract and guaranteed price in advance.

DGA is another measure of transaction costs. Growers who belong to a marketing association would have the association negotiate in the spot market for them. Since there is not an actual auction in Hastings, but growers entrust their output to a broker who negotiates a sale for them, growers should expect that agents representing the growers would be more skillful in negotiating higher prices than brokers operating on behalf of only the broker. This should cause growers to be more inclined to use the spot market, through the association.

Finally, DPKHS is utilized as a technology measure. Growers owning all or part of the necessary processing and loading facility would be, in effect, partially integrated, and providing some of the services a contractor might provide for him; the grower having an interest in packinghouse is hypothesized to be less likely to enter into a contract.

Data

Data for these analyses were obtained from secondary sources, and from direct surveys of market participants. All known buyers of chip potatoes through contracts in the Hastings, Florida, market were contacted in person. All growers of the area were mailed a questionnaire, and the response rate was 30 percent. The questions pertained to firm characteristics and contract specifications. Appendix B contains a discussion of the Hastings, Florida, potato market and Appendix C contains a copy of each type of questionnaire used in this study.

In collecting data, both marketing and exchange services were investigated as variables for the hedonic price analyses of contracting

and the spot market. A pooled time series, cross-section analysis was conducted over a five-year time span of grower contracts for chip potatoes; a 31-year time series analysis was conducted upon the spot market.

Table 3 presents the source for each variable used in this study. Appendix C also contains data used in analyses.

Econometric Problems

Each of the analyses presented econometric considerations. The hedonic contracting analysis was based on a pooled cross-section time series model. Problems arise in this type of analysis because of correlations among the same firm's observations over time when firms are pooled.

Data for the hedonic price analysis of contracts were collected from 19 area growers. Pooling was first accomplished by assuming that the difference among firms was a fixed effect. An F-test was constructed in which each grower was represented by a "dummy variable." An ordinary least squares regression was performed on this model and the results compared to a regression which assumed that firms were not different. The F-test indicated that at the .05 level there was no evidence of fixed effect differences among firms which would preclude pooling without dummy variables for each firm. Appendix D contains the information concerning this procedure.

Even when there are indications that there are no fixed effect differences among firms, however, there may be random differences among firms which are contained in the error term. For firm i in period t, the error term would be that of Equation (14)

Table 3. Data sources for variables in empirical analysis

Variable	Source
DPR	Grower survey questionnaires
PFMCON	Grower survey questionnaires
HVSAY	Grower survey questionnaires
PCA	Grower survey questionnaires
QUAL	Grower survey questionnaires
DELAY	Grower survey questionnaires
INFO	Grower survey questionnaires
VARSP	Grower survey questionnaires
DFSMP	Grower survey questionnaires
D1 - D4	Yearly "dummy variables"
SMACVA	Florida Crop and Livestock Reporting Service [1976] and Brooke [1949-1980]
DFCMP	Florida Crop and Livestock Reporting Service [1976]
DFCOM	Market participants
TSHIP	Florida Crop and Livestock Reporting Service [1976] and USDA, ESCS [1949-1980]
DBLK	USDA, ESCS [1949-1980]
DCON	Grower survey questionnaires
ACRE	Grower survey questionnaires
FMAGE	Grower survey questionnaires
DGA	Grower survey questionnaires
DPCA	Grower survey questionnaires
DPKHS	Grower survey questionnaires

$$(14) \quad \omega_{it} = \mu_i + \nu_{it}$$

where μ_i is the portion of the error term attributed to random difference in firms and ν_{it} is a normal random disturbance. (See Kilmer and Tilley [1979] for a discussion of this problem.) They point out that, "Because the error term for each observation associated with a particular firm contains μ_i, there is a correlation among errors (ω_{it}) of the same firm" [Kilmer and Tilley, 1979, p. 37].

The same situation may exist for the present study data. The variance of this error term can be expressed as Equation (15), following Kilmer and Tilley

$$(15) \quad \sigma^2 = \sigma_\mu^2 + \sigma_\nu^2.$$

They utilized a maximum likelihood procedure to estimate ρ, which was used to correct for correlated errors, where ρ represented the portion of total variation due to random differences among firms. This is shown in Equation (16).

$$(16) \quad \rho = \sigma_\mu^2 / \sigma^2$$

It would be desirable to test this value to determine if it is significantly different from zero (meaning that the variance has components) but no direct test is available. However, Judge [1980] recommends a test developed by Breusch and Pagan to test the null hypothesis that the random firm differences are equal to zero. The test and its results are presented in Appendix D. When this test was

conducted, the null hypothesis was not rejected at the .05 level and thus variance components were not used; the model was estimated by ordinary least squares, assuming no fixed or random differences among firms.

The time series analysis of the spot market presented a different problem. Time series analyses frequently exhibit autocorrelation problems. It is hypothesized that these autocorrelations exist because of omitted variables, and steps must be taken to include the effect of correlations of the error terms over time [Maddala, 1977]. A computer program for determining the autoregressive scheme (AR) or moving-average scheme (MA) or combination (ARIMA) developed by McClave in the Statistics Department at the University of Florida was used to determine the autocorrelation structure of the present model. It was found to be a second-order autoregressive scheme, and thus, it was estimated on the basis of this finding. The Statistical Analysis System (SAS) provides a procedure which is similar to the method of Cochrane-Orcutt for estimation of an appropriate transformation weight.

Finally, the analysis of characteristics of growers who did and did not contract presented the problem of estimation with a dichotomous dependent variable. This discussion will follow Nerlove and Press [1973]. They point out that if the dependent variable in analysis is a 0-1 variable which has a value of one if the event in question occurs, zero otherwise, then estimation of the regression equation $Y_j = X_j' B + e_j$ by ordinary least squares will result in estimates which are inefficient. If the nature of the problem studied demands that the larger the value of $X'B$ the greater the probability of Y taking the value of one, then the true probability function will follow the sigmoid or

S-shaped cumulative distribution function, lying between zero and one. The Logit procedure assumes a normal distribution (it has been shown that the procedure works well with other common population distributions also) and fits a maximum likelihood estimator to that assumed cumulative distribution function.

The Logit analysis is a maximum likelihood estimation technique used to predict the effect of variables on the probability of the observed entity engaging or refraining from participation in the dependent variable activity. Contracting was the dependent variable in this analysis, and the Logit procedure used the independent variables (firm characteristics) to predict their effect on observed grower selection of contracting or the spot market.

Models Estimated

Hedonic Price Analysis

Evaluation of services associated with alternate vertical exchange mechanisms is the key element in the present study. Payment for marketing and exchange services was hypothesized as one reason for prices to differ between spot markets and contracting. In order to evaluate these services, a hedonic price analysis of the spot market and a hedonic price analysis of contracts were performed on data pertaining to the Hastings, Florida, chip potato market. The general equation for estimating implicit prices is presented as Equation (17)

$$(17)\quad P_{EX_i} = \hat{P}_B + \hat{\beta}_1\, se_{1,i} + \hat{\beta}_2\, se_{2,i} + \ldots + \hat{\beta}_n\, se_{n,i} + \hat{\gamma}_1\, sd_{1,i} + \hat{\gamma}_2\, sd_{2,i} + \ldots + \hat{\gamma}_j\, sd_{j,i} + \varepsilon_i$$

where P_{EX_i} is observed exchange price in vertical exchange mechanism i; $\hat{P}_B$ is the intercept, which represents the base good price; $\hat{\beta}_n$'s represent implicit exchange service and marketing service prices; $\hat{\gamma}_j$'s represent the adjustments of observed price due to supply and demand changes and ε represents a normal error term with mean zero and variance σ^2.

Equation (18) presents the ordinary least squares equation estimated for each contract.

$$(18)\quad DPR_c = \hat{P}_B + \hat{\alpha}_1 D1 + \hat{\alpha}_2 D2 + \hat{\alpha}_3 D3 + \hat{\alpha}_4 D4 + \hat{\alpha}_7 QUAL_c + \hat{\alpha}_6 PCA_c + \hat{\alpha}_5 VARSP_c + \hat{\alpha}_7 PFMCON_c + \hat{\alpha}_8 HVSAY_c + \hat{\alpha}_9 INFO_c + \hat{\alpha}_{10} DELAY_c + \varepsilon_c$$

where DPR_c is the deflated price of contract c; $\hat{P}_B$ is the intercept, which is an estimate of the base good price; D1 is a 0-1 variable equal to one for the 1979-80 season, zero otherwise; D2 is a 0-1 variable equal to one for the 1978-79 season, zero otherwise; D3 is a 0-1 variable equal to one for the 1977-78 season, zero otherwise; D4 is a 0-1 variable equal to one for the 1976-77 season, zero otherwise; the 1975-76 season is represented by D1-D4, all equal to minus one; $QUAL_c$ is a 0-1 variable equal to one if the contract specified a quality; PCA_c is a 0-1 variable equal to one if the grower had a PCA loan; $VARSP_c$ is a 0-1 variable equal to one of a variety was specified in the contract; $PFMCON_c$ is the percentage of expected grower output which was committed to contract; $HVSAY_c$ is a +1 or -1 variable equal to one if the buyer set harvest and -1 if the grower set harvest; $INFO_c$ is a 0-1 variable equal

to one if the buyer provided information or technical advice to the grower in contract c; and $DELAY_c$ is the number of days after harvest before the grower received payment for his potatoes in contract c.

Equation (19) is the equation estimated for the spot market hedonic price analysis.

$$(19)\quad DFSMP_t - DFCOM_t = \hat{P}_{B_t} + \hat{\beta}_1\, SMACVA_t + \hat{\beta}_2\, DFCMP_t + \hat{\beta}_3\, TSHIP_t + \hat{\beta}_4\, DBLK_t + \hat{\beta}_5\, TRD + \varepsilon_\tau$$

where DFSMP is deflated spot market price in year t; DFCOM is deflated broker commission in year t; $\hat{P}_B$ is an estimate of the base good price; SMACVA is a measure of grower price risk, based on the previous year's deflated difference of price divided by average cost of production minus the historical average price divided by average cost of production, all squared; DFCMP is the previous two seasons' difference between minimum deflated spot market price; TSHIP is the proportion of area output in year t shipped by truck; DBLK is a 0-1 variable equal to one for years in which potatoes were shipped bulk instead of bagged.

It should also be emphasized at this point that estimates of implicit prices could be hampered by lack of variation in the data, or high correlation of different service factors. For example, all services associated with the spot market were not measured because some service factors did not change during the period of observation. Only changes

in services could have implicit prices estimated. In contracts, if all contracts contained one service factor, then the implicit price of that service could not be ascertained. Likewise, service factors which always appeared in pairs could not have separate prices estimated successfully by a hedonic analysis.

Analysis of Grower Characteristics

The appropriate Logit equation for each gorwer in this study is presented in Equation (20)

$$(20) \quad DCON_i = \hat{\gamma}_0 + \hat{\gamma}_1 ACRE_i + \hat{\gamma}_2 FMAGE_i + \hat{\gamma}_3 DGA_i + \hat{\gamma}_4 DPCA_i + \hat{\gamma}_5 DPKHS_i + \varepsilon$$

where DCON is a 0-1 variable which has a value of one if grower i contracted for any chip potatoes, zero otherwise; ACRE is acreage under cultivation in grower i's firm; FMAGE is the number of years grower i has been producing potatoes; DGA is a 0-1 variable equal to one if grower i was a member of either of the local grower's associations; DPCA was a 0-1 variable equal to one if grower i obtained a loan from a Production Credit Association or other local bank; and DPKHS was a 0-1 variable equal to one if grower i owned all or part of a packinghouse.

Summary

This Chapter presented empirically testable models based on the theoretical development in Chapter III and Appendix A. Selection of variables was discussed. Service factors were classified by the "four

categories of incentives" and exogenous supply and demand measures were included where appropriate.

Sources of data were presented. Where possible, information was obtained from secondary sources. Also, a survey questionnaire was distributed to area market participants: all buyers were contacted in person and growers by mail, telephone and in person. Twelve buyers and about 30 sellers responded. Data from these surveys were utilized in the analysis of contracts and the test of differences in grower characteristics between those who contracted and those using the spot market.

Econometric problems associated with each part of the study were presented and discussed. It was found that the firms could be pooled for the contract analysis, and that no fixed or random differences among firms were present. In the time series analysis of the spot market, it was found that a second order autocorrelation (AR) scheme was present and autoregressive computer techniques were used to estimate the empirical model. In analyzing firms' choice of contracting or spot market use, special maximum likelihood procedures were appropriate, rather than ordinary least squares. A Logit procedure was selected for this analysis.

Finally, the mathematical models were presented for each part of the empirical test. The results will be presented and discussed in the next chapter.

CHAPTER V
ANALYSIS OF EMPIRICAL MODELS

Introduction

Chapter III and Appendix A presented the suggestions that different services were associated with different vertical exchange mechanisms. These services were used to explain in part the observed exchange price in contracting and the spot market, and differences in price between the two vertical exchange mechanisms. Firm optimizing behavior, based on satisfaction of first order conditions of equating marginal value product or marginal cost with service price, was also explained on the basis of services. Differences in firm ability to produce and utilize services were hypothesized to account for differences in firm selection of vertical exchange mechanism. This scenario was tested in three empirical models. The results of these models will be presented and discussed in this chapter.

The hedonic price analysis of contracting will be presented, discussed and interpreted. Then, the hedonic price analysis of the spot market will be presented. Finally, the Logit analysis, as a test for differences in firm cost curves, will be presented and discussed.

Hedonic Price Analysis of Contracts

The mathematical model presented in Chapter IV (Equation (18)) was estimated by two different statistical techniques: ordinary least

squares and least squares with dummy variables. Appendix D contains the estimates and test results of the least squares with dummy variables and the variance components. It was found in both analyses that ordinary least squares estimation was not prohibited. Table 4 contains the ordinary least squares results of the pooled cross-section time series analysis of contracts.

The ordinary least squares produced estimated coefficients of the expected sign for two statistically significant service factors. QUAL and PCA were hypothesized to represent factors desired by buyers and were expected to have a positive effect on contract price. Both represented measures of quality control by the buyer. The specification of a grade or quality had the larger effect of an estimated $0.12 per bag increase in contract price. The quality factors associated with grower patronage of a PCA were valued at an estimated $0.07 by buyers. The other variables were not significant at the .05 level, but the above two factors suggest that the growers are paid for some of the services they may provide buyers.

Most of the other service factors estimated were both statistically not significant and of the opposite hypothesized sign. There could be several explanations for this. The actual sample of growers could be sufficiently small that the cross-section effect of differences in services could not be measured by this sample; many of the services appear in pairs, so that the effect of each one is masked by the others; or these may be services which are actually of little value to either party.

Table 4. Regression results of pooled cross-section time series hedonic price analysis of contracting

Variable	Estimated coefficient	Standard error
Intercept	1.98*	0.043
D1	-0.20*	0.02
D2	-0.31*	0.02
D3	-0.05*	0.02
D4	0.31*	0.02
QUAL	0.12*	0.03
PCA	0.07*	0.03
VARSP	-0.006	0.03
PFMCON	-0.00007	0.0004
HVSAY	0.02	0.02
INFO	0.01	0.03
DELAY	-0.0002	0.0004

Statistics for Model:	
MSE =	0.011
R^2 =	.86
F Ratio =	53.99
Standard Error =	.106

* Significant at the .05 level.

Determination of harvest date should influence price, however. It seems intuitive that each party has potential gain from setting the date of harvest. Specification of variety also seems as though it should have value. However, the new variety, the Atlantic, was not introduced into the area until the 1977 season and the five-year time series may be too long to look at the price effect of variety.

No benefits to growers were statistically significant in this study. INFO was the only potential benefit observed within contract specifications, and the positive coefficient, although not statistically significant at the predetermined level, could be capturing differences in quality of output, which would also be a buyer benefit. DELAY is estimated close to zero. Although little can be said because of its low level of statistical significance, it suggests that growers are not sensitive to delays in payment. If the grower knows in advance how long it will be after harvest before he is paid, he may be able to arrange his financial affairs to accommodate this delay so that he is not greatly inconvenienced by it.

Since all estimated coefficients represent implicit prices for services in constant (1967) dollars, to interpret the equation for each year requires re-inflation of prices. Raw data from Appendix C should be multiplied by the re-inflated implicit prices to interpret the results for a given contract. Note that for the year 1976, each of the yearly dummies of 1977-1980 should be multiplied by minus one. As an example of interpretation, to examine a contract for 1980, the re-inflated implicit prices would be those of Equation (21).

$$(21)\quad PR_{c,1980} = \$4.09 + \$0.28\ QUAL + \$0.16\ PCA - \$0.02\ VARSP - \$0.00\ PFMCON + \$0.05\ HRVSAY + \$0.02\ INFO - \$0.00\ DELAY$$

where PR_c is the 1980 price for contract c and the other variables are as defined. QUAL and PCA are significant at the .05 level, and if an "average" sized grower (100 acres) had included these factors in 1980, the above model predicts he would have received $5,600 in additional revenue for including a quality provision ($0.28 for 20,000 bags); and $2,300 in additional revenues for the quality aspects associated with the PCA. This totals $8,800 in increased revenues, or about 10.75 percent of additional revenue for inclusion of those services.

The estimated intercept for this equation is $4.09. This is an estimate of the base good price. Because of the construction of the yearly shifters (D1-D4) it has also been possible to isolate the effects of the 1976 year from the estimate of the base good price. This estimate is, therefore, a measure of only the base good price (plus any factors misspecified by the model or services which were common to all contracts). This estimate appears reasonable; the average cost of production for the 1980 season was reported at $4.25 per hundredweight. The base good should be a measure of the value of potatoes, with no services of any kind, and average production cost should approach this value. The regression estimate suggests that it does.

Hedonic Price Analysis of Spot Market

The mathematical model presented in Chapter IV (Equation (19)) was estimated by a second-order autoregressive scheme. Results of this

regression are presented in Table 5. Implicit prices for services were estimated in real dollars (1967 = 100) values.

Both risk variables, SMACVA and DFCMP, were asymptotically significant at the .05 level, and of the expected sign. All variables in the equation were of the hypothesized sign. The estimated coefficient of SMACVA suggests that the market price is extremely sensitive to variance of the ratio of price to average cost. It was hypothesized that this coefficient would possess a positive coefficient, which the estimate does, but the magnitude of the coefficient suggests that for each $1.00 change in this measure, the spot market price increases by $2.04. This would suggest extreme sensitivity to volatility in the market, and a wide change in patronage of the market from one season to the next. However, the data values for SMACVA are quite small, indicating that there is little change in the ratio of price to average cost from one year to the next, so the high value of the estimated coefficient is not unrealistic.

As an example of interpretation, this equation will be re-inflated to 1980 dollars. Again, raw data values from Appendix C are multiplied by the implicit price for services after the implicit prices have also been re-inflated. Equation (22) shows the 1980 implicit price values.

$$(22)\quad SMP_{1980} = \$3.86 + \$0.24\ SMACVA - \$0.38\ CMP - \$0.60\ BLK + \$1.17\ TSHIP + \$1.13\ TRD$$

where SMP is the average 1980 spot market price; SMACVA is the ratio of price to average cost variance value for 1980; CMP is the 1980 value of the change in minimum spot price, BLK is bulk shipment of potatoes;

Table 5. Regression results of time series hedonic price analysis of spot market

Variable	Estimated coefficient	Standard error
Intercept	1.68*	0.54
SMACVA	1.48*	0.69
DFCMP	-0.34*	0.16
DBLK	-0.26	0.23
TSHIP	0.56	0.69
TRD	0.49*	0.15

Statistics for Model:	
MSE	= 0.245
R^2	= .55
F Ratio	= 6.04
Standard Error	= .495

* Significant at the .05 level.

TSHIP is the proportion of 1980 output shipped by truck; and TRD is the trend for exogenous supply and demand shifts over time.

The two risk factors, SMACVA and CMP, accounted for about 12 percent of the observed 1980 price. SMACVA indicates a decrease in supply this year because of the price fluctuation of the previous two years. The above equation suggests that the average price this year was $0.24 higher than it would have otherwise been because of decreased supply this year. CMP suggests, however, that the average price was $0.38 lower because the minimum spot price increased over the previous two seasons. This is hypothesized to cause growers to increase supply to the spot market, which causes a price decrease.

The estimate of the base good price for 1980 is $3.86. This is lower than the estimate for contracting, which was $4.09. The theoretical development of this study suggested that the base good was homogeneous among all vertical exchange mechanisms. The base good price should, therefore, be equal among all vertical exchange mechanisms. These two estimates differ by 6 percent, which suggests that the base good prices between the spot market and contracting may be comparable. Excluding adjustments for time, the estimated base good price for contracting is $1.98; it is $1.68 for the spot market analysis. The difference between these two figures is 15 percent, which again suggests that the two estimates may be comparable. This is evidence that differences in services do, at least in part, account for differences in price between contracting and the spot market.

Analysis of Grower Characteristics

Implicit service prices were estimated for characteristics of the spot market and contracting in the previous two sections. It was hypothesized in the theoretical development of Chapter III, however, that not only were there different services and implicit prices associated with each vertical exchange mechanism, but that differences in firms' capabilities of utilizing these services accounts for firm selection of vertical exchange mechanisms. It was hypothesized that the differences in firm selection rested upon differences in firm cost curves. Thus, the Logit analysis presented here was used as an adjunct to the hedonic price analyses to test for differences among growers who contracted and those who did not.

Exact estimation of firm cost curves would have provided an excellent test of this hypothesis, but detailed individual firm records are not available. However, data pertaining to firm characteristics has been collected, and this was the data used in the Logit analysis. It is suggested here that these observable firm characteristics suggest differences in underlying firm cost curves. The hypothesis to be tested in this analysis was that firm characteristics of growers who contracted differed from characteristics of those who did not.

The Statistical Analysis System (SAS) was used to estimate the model presented in Chapter IV (Equation 20)). However, SAS would not estimate this desired model. Apparently the matrix could not be inverted and a message of "underflow" resulted. Therefore, partial models were estimated instead. Through the use of several combinations, a pattern begins to appear that all variables are consistently estimated

of the same sign in different model specifications. Also, the same variables are usually asymptotically significant or not at the .05 level with different specifications. Several of these models are presented for illustrative purposes, but will be summarized as one model. Tables 6-10 show different combinations of the five characteristics selected for analysis.

ACRE and DPCA were consistently estimated as being positively related to contracting, while DGA, FMAGE and DPKHS were consistently associated with use of the spot market. ACRE and DGA were almost always statistically significant at the .05 level, FMAGE was in one model, and DPKHS and DPCA were never significant at the .05 level.

Along with asymtotic t-ratios, an assessment of the probability of correct assignment of the firms by the model is presented. This is another measure of its performance. All models correctly predicted contracting or spot market for the majority of observations with .90-.99 probability.

Care must be exercised in interpreting these results. Each model estimated is known to be only a partial model. Omitted variables are known to cause biased estimates, but the direction of the bias is uncertain [Maddala, 1977]. Nevertheless, they do suggest at least one grower characteristic is associated with contracting and one with spot market use. All estimated coefficients were of the hypothesized sign, however, and constitute some weak evidence of other grower characteristics which might be associated with selection of vertical exchange mechanisms.

All Logit analyses do support the basic premise that firms choosing to contract possess differences in objective functions, if it is assumed

Table 6. Logit analysis of grower contracting factors--variables: ACRE, DPKHS, DGA

Explanatory variable	Coefficient	Asymptotic T-ratio	Probability frequencies for model	
			Probability of correct assignment	Frequency
			.00 - .09	1
Constant	-0.411110913	0.402549880	.10 - .19	0
			.20 - .29	1
ACRE	0.211068018D-01	2.23396085	.30 - .39	0
DPKHS	-2.87450097	1.27095428	.40 - .49	0
DGA	-2.83594173	2.01590642	.50 - .59	3
			.60 - .69	1
			.70 - .79	0
			.80 - .89	2
			.90 - .99	25
			1.00	0
			Total	33

Table 7. Logit analysis of grower decision to contract--variables: ACRE, DGA, FMAGE

Explanatory variable	Coefficient	Asymptotic T-ratio	Probability frequencies for model	
			Probability of correct assignment	Frequency
			.00 - .09	1
Constant	1.82633949	1.01976478	.10 - .19	0
			.20 - .29	0
ACRE	0.218318318D-01	2.14716110	.30 - .39	0
DGA	-4.22644473	2.23543819	.40 - .49	1
FMAGE	-0.784026738D-01	1.63911367	.50 - .59	3
			.60 - .69	0
			.70 - .79	0
			.80 - .89	2
			.90 - .99	26
			1.00	0
			Total	33

Table 8. Logit analysis of grower contracting--variables: FMAGE, DPKHS, DGA

Explanatory variable	Coefficient	Asymptotic T-ratio	Probability frequencies for model	
			Probability of correct assignment	Frequency
			.00 - .09	1
Constant	3.53084464	2.43614038	.10 - .19	1
			.20 - .29	2
FMAGE	-0.567804548D-01	1.92904799	.30 - .39	0
DPKHS	-0.438057999	0.332048814	.40 - .49	0
DGA	-3.86358192	2.99537987	.50 - .59	0
			.60 - .69	2
			.70 - .79	6
			.80 - .89	11
			.90 - .99	10
			1.00	0
			Total	33

Table 9. Logit analysis of growers who did and did not contract--variables: ACRE, DGA, DPKHS

Explanatory variable	Coefficient	Asymptotic T-ratio	Probability frequencies for model	
			Probability of correct assignment	Frequency
			.00 - .09	1
Constant	-0.411110913	0.402549880	.10 - .19	0
			.20 - .29	1
ACRE	0.211068018D-01	2.23396085	.30 - .39	0
DGA	-2.83594173	2.01590642	.40 - .49	0
DPKHS	-2.87450097	1.27095428	.50 - .59	3
			.60 - .69	1
			.70 - .79	0
			.80 - .89	2
			.90 - .99	25
			1.00	0
			Total	33

Table 10. Logit analysis of grower contracting factors--variables: DPCA, ACRE, FMAGE

Explanatory variable	Coefficient	Asymptotic T-ratio	Probability frequencies for model	
			Probability of correct assignment	Frequency
			.00 - .09	0
Constant	-6.41134068	1.48095718	.10 - .19	1
			.20 - .29	0
DPCA	6.15612070	1.46462941	.30 - .39	0
ACRE	0.280083037D-01	1.82690850	.40 - .49	3
FMAGE	-0.573236667D-01	0.976971524	.50 - .59	0
			.60 - .69	3
			.70 - .79	3
			.80 - .89	0
			.90 - .99	23
			1.00	0
			Total	33

that the differences in characteristics are evidence of differences in underlying cost curves.

Summary

In conclusion, the theoretical structure for analysis of firm selection of vertical exchange mechanisms and its relationship to observed prices was generally supported by the empirical models of the Hastings, Florida, chip potato market. Implicit prices for several service factors were estimated by ordinary least squares, and by assuming that firms equated these implicit service prices with marginal products from their objective functions, different firm characteristics were shown to be associated with different firm selection of vertical exchange mechanisms by a Logit analysis across growers.

Different service factors were found to be associated with the spot market than were determined to be important in contracting. Quality control appeared to be the most significant factor in contracting. Two different variables associated with quality were found to be positive and statistically significant factors in influencing contract prices. In the spot market analysis, risk appeared to be the primary influence. Two types of grower price risk were found to be statistically significant in influencing spot market price over time.

Although different service factors were examined between the two markets, it was found that the estimated base good price was close for the two analyses. This constituted some evidence that differences in service can explain some of the difference in price between the two vertical exchange mechanisms.

A caveat is in order at this point, however. The two data series were not comparable in that one was a pooled cross-section time series for five years (contracting) and the other was a 31-year time series (spot market). Differences in the series could account for differences in the estimates. Also, there may be implicit prices for services imbedded within the intercept estimate for both analyses. Only services which differ across firms or over time could be measured. Occurring pairs of services probably masked at least one pair of services in contracting (harvest date and specification of variety) and lack of change in several services prevented their estimation in the spot market analysis. For example, the value of knowledge of the existence of the market, or the value of government agencies' reports of prices, volumes, etc., could not be measured. Thus, the interpretation of either base good estimate must be approached with caution.

The two statistically significant quality measures from contracting suggest that the buyer's demand for control of the characteristics of the output is one of the most important motives for contracting. This is consistent with the theory reviewed in Chapter II of this study. The fact that no benefits to growers were measured in this analysis does not disprove the suggestion. There were few factors which could have been considered in this market. Other markets, such as processed vegetables, are known to have more service factors included in contracts. The two variables which might have also influenced price in this market, VARSP and HVSAY, could have lacked evidence of payment because the new variety, the Atlantic, was not even introduced to the area until 1977, and did not represent a significant acreage in the area until this

year (1980). The two variables frequently appeared together in the data also, which could have prevented them for appearing significant.

In the spot market time series analysis, the most influential variable in the model appeared to the measure of spot market price variance. This is not surprising. Numerous articles in the literature pertaining to selection of alternate vertical exchange mechanisms suggest that variance of spot market prices is indeed a significant factor in firm selection. The other measure of risk, DFCMP, was used as a measure of a marketing service which benefitted growers and was hypothesized to have a negative effect on price.

CHAPTER VI
SUMMARY AND CONCLUSIONS

Introduction

The attack of this study was two-pronged. Its purpose was to explain prices in different vertical exchange mechanisms and also to explain firm selection of different vertical exchange mechanisms. These goals were both achieved by examination of the services associated with each vertical exchange mechanism. The mechanism for this analysis was developed theoretically in Chapter III, developed empirically in Chapter IV and tested econometrically in Chapter V. The significance of these findings will be discussed in this chapter.

Hedonic Price Analyses

Both hedonic price equations provided statistically significant coefficients of the hypothesized sign. This constitutes evidence that there are services associated with each vertical exchange mechanism, and that these services do indeed affect observed exchange price. The composition of the two hedonic models also highlights the fact that the service factors of the two vertical exchange mechanisms examined in this study are different. However, it was still possible to classify each factor as one of the "four categories of incentives" outlined by Helmberger et al. [1980].

The two hedonic analyses contained at least one statistically significant service variable of the hypothesized sign (exogenous factors excluded) which demonstrated the effect of a service which benefitted buyers and one which benefitted sellers. Service factors benefitting buyers were hypothesized to be a positive influence on price. In the contract analysis these variables included two measures of quality: QUAL and PCA. Quality was a direct measure of inclusion of quality specification within the contract and PCA was a summary variable hypothesized to capture several desirable grower characteristics correlated with loans from PCA's. No services which were hypothesized to be of benefit to growers were found to be statistically significant. This can be either because they are of little value to growers or (more possibly) because it was not possible to isolate their effects. The value to the grower of the contract specification of a final price (price risk reduction) could not be measured, for example, becasue all contracts contained a price.

Likewise, no implicit prices which were of benefit to buyers were statistically significant in the hedonic price analysis of the spot market. The value of buyer benefits could be imbedded within the intercept, again because of lack of variation in the data.

Growers who chose contracting in the hedonic price analysis of contracts were found to receive premiums for the services they provided the buyer within the specifications of the contract. No attempt was made to determine if these prices were "fair" (competitive). In order to evaluate the "fairness" of observed prices, it would be necessary to know the marginal physical products and relative prices for each party, in order to determine if each factor was paid its marginal value product

in purchase, and provided up to its marginal cost of production in supply.

Growers using the spot market were found to be influenced by price risk in the market. Two measures of risk were statistically significant and of the hypothesized sign, indicating a benefit to growers if the price/cost ratio variance decreased, or if minimum spot price increased, growers perceived the change as a benefit, and were willing to sacrifice some of the observed price to use the market more extensively.

Growers who are unaware of differences in contract specifications might benefit from the information found within this analysis, in that they could find a contract more nearly suited to their firm's production advantages, and growers trying to decide among contracts might find the implicit service prices an aid in arriving at their firm's selection of vertical exchange mechanisms. Growers interested in estimates of implicit prices gained from analysis of market data might be interested in comparing the average prices estimated with their own estimates of these prices, or the implicit price they feel they are receiving for services measured in this study. This should help them in selection of optimal contract specifications.

Growers choosing between the spot market and contracting might be interested in the effects of price variance and change in minimum price upon observed price. Those more able to withstand adverse prices might be less interested in spot market price vagaries. These growers might be interested also in predicting the impact of regulation, as in a Marketing Order, upon spot market prices. Growers wishing to decide between spot market and contract use might also be interested in using

this price analysis as a predictive tool, by using their perceived values of the relevant variables to predict which price will be most advantageous to them for the coming season. Buyers might find the same benefits from this analysis.

Parties involved in each market might find implicit prices of services to be a useful guideline in policy decisions, too. For example, experimentation with different mechanisms for dispersing price information, such as electronic price reporting systems, could be evaluated in terms of their effect on market price. If the cost of the service exceeded its value (implicit price) then it would not be considered a useful improvement in market technology. Likewise, governmental regulatory services could be measured by this method, and the implicit price of the service compared with its cost to the regulatory agency.

Buyer demand for services associated with quality risk reduction dominated the contract hedonic price analysis; grower demand for price risk reduction was the primary service category measured in the hedonic price analysis of the spot market. Contract services amounted to 10.75 percent of observed price, and about 12 percent of observed spot market price was accounted for by service prices. The base good price estimates were similar, which provided some evidence of comparability between the two base good products, which the theoretical development of this study suggested should be true. Thus, a measureable portion of observed price within each vertical exchange mechanism was explained by the analysis, and also part of the difference in price between the two vertical exchange mechanisms.

The hypothesis that differences in grower cost curves determined differences in selection of vertical exchange mechanisms was also

supported by the analysis. Thus, a positive explanation for the problem of "thin markets" has been proposed and to some degree supported. Changing from spot to contract may represent an optimal, positive movement rather than evidencing a problem with spot markets which policy makers must address and try to correct.

Other Applications

The theoretical structure of analysis developed in this study could be applied to any market (or industry) for which data are available. It could prove fruitful in analyzing markets which have been labeled as "problem" markets because they are thinly traded. Finding that firms are evaluating implicit prices and service quantities between vertical exchange mechanisms in order to select contracting or spot market use should alleviate fears that firms are being forced by malfunctioning spot markets to use alternatives, such as contracting or vertical integration. Recognition of differences in services available among vertical exchange mechanisms should also provide useful insights into industry behavior regarding selection of vertical exchange mechanisms. Researchers interested in market performance should find a hedonic analysis of implicit service prices to be a useful tool in comparing prices among vertical exchange mechanisms.

In a more general context, the method of price analysis developed in this study could be useful to a wide range of producers and market analysts in explaining observed prices in different vertical exchange mechanisms, and in gaining an understanding of factors which influence these prices to move in different directions sometimes.

In terms of the Hastings, Florida, chip potato market, policy makers and other public employees concerned with this market might be interested in performing this type of hedonic price analysis again in the next few years, as a means of measuring implicit prices more accurately, especially in the spot market. Hedonics can only capture implicit prices when the characteristics change. Thus, sampling the spot market services at different points in time might be more effective in isolating services. This technique would also provide interested parties with a means of evaluating market performance over time. Service characteristics which have not changed should not produce changes in implicit service prices, and this would be one means of evaluating market performance. Finally, information regarding these implicit prices should be of value to all participants in the market, as an aid to their own decision-making framework.

Suggestions for Further Research

If firm production functions were known, the combination of evaluation of firm supply and demand functions for services, and evaluation of implicit service prices, could be used to address the reasons for firm selection of vertical integration as the optimal vertical exchange mechanism. Nothing was presented in this study concerning vertical integration because data were not available. If the firm's objective function could be estimated, however, then implicit service prices could be determined by the point of production observed by the firm, assuming that first order conditions were satisfied at that point. Implicit service prices for the vertically integrated firm could then be compared with implicit prices for the same services produced outside the firm,

and these price differences (if any) could be used to explain firm adoption of vertical integration.

Knowledge of firm production functions would also provide a more complete test of the theoretical framework presented in this study. If production functions were known, then observed points of firm production could be evaluated in terms of marginal products and implicit service prices. This would be one promising test which could be conducted for the Hastings, Florida, spot market.

Market power and risk were the two "categories of incentives" which were most difficult to incorporate into the empirical models. Further investigation into measuring the value of risk reduction are needed before hedonic analyses can be applied without certainty of model misspecification. There seems to be a good amount of research into the incorporation of risk into empirical analysis, and any improvements set forth in more traditional analyses (supply or demand or both) should be useful in a hedonic price analysis of services. Measures of market power center about whether or not prices represent a "competitive" equilibrium. Firm level data on objective functions should provide a means of investigating this aspect of market behavior.

Hedonic price analyses across industries may also provide an interesting line of investigation. Should the same service have the same implicit price in similar industries? For example, should specification of harvest date or variety specification have the same value to sweet corn producers as to potato producers? How sensitive are other markets to price variation? To minimum spot price changes? The same questions could be investigated for other potato markets within the U.S. or abroad.

Finally, the interplay between changes in services associated with each vertical exchange mechanism and changes in optimal firm selection could be profitably explored. It was suggested in the theoretical development of this study that market forces determine the implicit price for services associated with each vertical exchange mechanism. The firm equates marginal value product or marginal cost with these implicit prices to determine optimal selection of vertical exchange mechanisms. Thus, either changes in firm cost functions or changes in market prices can change optimal selection. How these two forces interact and change over time is another significant area of study suggested by the development of the present work.

Conclusions

Tests of Hypotheses

An investigation of the relevant factors influencing the spot market or contracting in the Hastings, Florida, market revealed different services associated with each vertical exchange mechanism. These services were included as independent variables in the empirical analyses. Estimation of their implicit prices by hedonic price analyses provided evidence that the valuation of services was one influence of prices in obth the spot market and in contracts signed between growers and processors or growers and brokers.

Hypotheses one and two in Chapter I pertained to the relationship of exchange mechanism and observed price. It was hypothesized that there were different characteristics associated with spot markets from those of contracting, and that these different characteristics accounted

or differences in price. Chapter III contained a theoretical development of this relationship, based on firm maximizing behavior. Implicit service prices were equated with marginal productivities to determine the combination of services and level of each service a hypothetical firm would provide or utilize. The hedonic analyses of the spot market and contracting presented in Chapters IV and V provided the empirical test. Different service characteristics were found for the spot market than were associated with contracting, and the hedonic price analysis of each provided estimates of each implicit service price.

The theoretical development in Chapter III was based on firm production functions. It was shown in Chapter III that firms with different production functions would find different combinations of services optimal. This could also explain why some firms would choose contracting, others use the spot market. A Logit analysis to predict use of contracting was presented as a test to this hypothesis in Chapter IV. It was found that firms choosing the spot market possessed different characteristics from those using some form of contract.

Summary

Empirical evidence was found which supported the argument that firm behavior and observed prices could be explained by the services associated with each vertical exchange mechanism. Implicit prices were estimated for services associated with each vertical exchange mechanism, and firm characteristics were found to differ between firms which contracted and those which did not.

Evidence was found which supported the argument that differences in services (and their associated prices) between the spot market and

contracting accounted for the observed differences in price between the two vertical exchange mechanisms.

Final Comment

In conclusion, the framework developed in this study has provided a means of explaining firm selection of alternate vertical exchange mechanisms, and isolating the implicit service prices within each mechanism which explain (at least in part) the price differences between contracts and the spot market in an empirical application of the model herein developed. This promises to be a useful technique for examining firm and market behavior, but there is still work to be done in developing the means of measuring all relevant service factors, and in circumventing the problem of hedonics presented by the fact that only service factors which have changed across firms or over time can be evaluated. This study, therefore, signifies only a beginning in evaluation of firm selection of vertical exchange mechanisms and its effects on market price.

APPENDICES

APPENDIX A
EXAMINATION OF EXCHANGE SERVICES

Introduction

Chapter III presented a development of firm evaluation of one grower exchange service, quality, by both the seller and buyer. It was argued that service factors from the "four categories of incentives" could be used as exchange service factors in a firm optimization context, and the purpose of this Appendix is to demonstrate how n of these factors can be incorporated into the firm's maximizing procedure. In general, it will be argued that service factors affect production decisions in the same manner than other inputs and outputs do. Service factors pertaining to technology and transaction costs would enter the production function as other input and output factors. Market power would not affect production functions, but optimal conditions would become imperfect competition criteria, rather than the conditions appropriate for perfect competition presented here.

A final point should be made regarding marketing versus exchange services. Whereas it is suggested that there is a joint product when exchange services are present, there is no such relationship when marketing services are considered. Therefore, market service factors can be incorporated directly into the grower's and processor's production function as input factors, and an evaluation of profit can be made without the complication of joint products for these factors. Profit, if the spot market is used, can then be compared with profit from contracting, and the firm chooses the mechanism which maximizes profit. (Expected profit would be the criterion in situations of uncertainty.)

Risk requires specific acknowledgement of imperfect information or some form of randomness in production function coefficients or prices. Risk will, therefore, be given individual attention in this analysis.

Risk Reduction as a Service Factor

There may be several forms of risk associated with production and purchase of the agricultural good. The grower will be uncertain of the amount of output he will produce from a given set of inputs because of vagaries in the weather. The processor will face some uncertainty of the quality of the potatoes he will buy. Potatoes may appear to be of good quality but fail to produce acceptable potato chips because of chemical changes which cannot be seen. There are also uncertainties about the timing of harvest and demand for the output.

Some of these risks would not be affected by the vertical exchange mechanism selected. Risk of adverse weather would be unchanged by selecting contracts or the spot market. Quality, as demonstrated in Chapter III, could be included as a risk factor directly in contract specifications for characteristics which can be observed. Likewise, uncertainties of timing can be included in contract specifications.

The final type of risk to be examined is price risk. The price risk of using the spot market can be included in the evaluation of contracting by the grower and processor. Since a contract must be signed in advance of harvest, the spot market price is not known when the contract is signed. The difference between expected spot market price and contract price can be used as a measure of the opportunity cost of contracting, however. The grower and processor must, therefore, evaluate expected spot market prices and profits. It will be assumed that

the grower's output consists of only the base good, B, which he will sell in the spot market. Since the spot market price is not known in advance, he must use expected price. Equation (1) illustrates the grower's expected profit function for using the spot market.

$$(1) \quad E(\pi) = E(P_B)\, B - P_X\, g(B)$$

where $E(\pi)$ denotes the expectation operator, B is the base good price, P_X is the price of the variable input, and $g(B)$ is the production function solved in terms of B. First order conditions become:

$$(2) \quad \frac{\partial \pi}{\partial B} = E(P_B) - P_X\, g'(B) = 0$$

or solving for marginal cost equal to expected price,

$$(3) \quad E(P_B) = P_X\, g'(B)$$

where the variables are as defined. The grower's response is now based upon a function of output price which is assumed to be composed of a fixed part (average price) and a random variable element which causes a distribution of prices about the mean. This is frequently measured as the variance of price and it has been shown by Carlton [1977] that output will decrease as price variability increases. The grower's supply function can then be expressed in terms of average price, variance of price, input price and marginal input. Equation (4) shows this.

$$(4) \quad \overline{P_B} = f(\text{var}(B),\, P_X,\, g'(B))$$

Equation (4) demonstrates two factors which can be used by the grower as a measure of opportunity cost. The average spot market price

(expected price) and the variance of price can both be used to evaluate opportunity costs of contracting. The grower would, therefore, include these factors in evaluating his contract option. How these factors are included in the hedonic price analysis will be examined next.

The grower's profit function from contracting would not include any factors for price risk. It is assumed that input prices are known then the contract is signed and that price and quantity are specified within the contract. Therefore, there is no price risk for the grower in the contract. Equation (1) and Equation (3) for the grower under contracting would be identical except that there would be no expectation of price; it would be known. Profit from contracting would, therefore, be known under these conditions. The grower would then have to compare the actual profit of contracting with the expected profit of the spot market. His selection would depend on his attitude towards risk, as well as average spot market price and its variance.

Assuming that the grower is risk averse, he would be willing to forego some potential profit in order to reduce price risk (variance of price). Thus, the average contract price would be less than the spot market price (ceteris paribus). As variance of the spot market decreased, it would be expected that growers would be more willing to utilize the spot market (since average spot price would exceed contract price). Decreases in variance of spot market price would, therefore, constitute a service factor, and the implicit price associated with this service could be estimated for both the spot market price and contracting if the spot market price variance changed over time or across similar production markets. If variance were unchanged, its implicit price could not be measured, even though it might have value.

Price risk would constitute an opportunity cost measure influencing a contract price, and a direct factor influencing spot market price. As spot market price variance increased, its expected influence on spot market price would be negative (because more growers would patronize the spot market). Decreases in spot market price variance would have a positive effect on contract price. This would be because buyers would have to offer a premium to make growers willing to leave the spot market in order to contract.

An analagous procedure can be demonstrated for the processor. The processor using the spot market would not know its price in advance, and thus, when evaluating the spot market as an opportunity cost in contracting, he would have to look at expected price also. Equation (5) shows the processor's expected profit if he uses the spot market.

$$(5) \quad E(\pi) = P_Y f(B) - E(P_B)$$

where his only variable input is the base good, B, and $E(\pi)$ denotes the expectation operator. The processor will maximize the expected value of his profit function by solving first order conditions, as in Equation (6)

$$(6) \quad \frac{\partial \pi}{\partial B} = P_Y f'(B) - E(P_B) = 0$$

or rearranging terms to show derived demand, Equation (7) shows marginal value product equated with expected input price

$$(7) \quad E(P_B) = P_Y f'(B) - E(P_B).$$

It was suggested in the grower analysis that the expected price is a

function of average price and its variance. This can be substituted into $E(P_B)$ in equation (7) above, which shows the processor evaluates both average price and variance of price in examination of expected profit from the spot market. The risk for the processor lies in committing himself to purchase inputs in advance. Because he is uncertain about future demand, he will not pay a premium to commit himself to the purchase of these inputs in advance [Carlton, 1977]. This partly explains why contract price is usually below spot market price.

The equilibrium condition for the marginal gorwer would be indifference between the spot market and contracting. The same would be true for the marginal processor. Indifference curves, rather than isoprofit, would then be appropriate.

Expansion of Analysis to n Variables

It was suggested in the text that the analysis of first order conditions for one service factor could be expanded to n variables by including a factor for each service element as an independent variable and by expanding grower output to an n-dimensioned line vector. This will now be illustrated.

The grower's multiple input and output function, written in implicit form, is shown in Equation (8).

$$(8) \quad F(B, se_1, se_2, \ldots, se_n; x_1, x_n, \ldots, x_r) = 0$$

where joint outputs include B and se_i's and inputs are x_j's. The profit function now becomes the difference between the sum of receipts and the sum of pyaments, subject to the grower's production function. This is shown in Equation (9).

$$(9)\quad G = B_B B + \sum_{i=1}^{n} P_{se_i} se_i - \sum_{j=1}^{r} P_{x_j} x_j + \lambda F(B, se_1, \ldots, se_n; x_1, \ldots, x_r)$$

First order conditions are:

$$(10)\quad \frac{\partial G}{\partial B} = P_B + \lambda F'(\ ) = 0$$

$$(11)\quad \frac{\partial G}{\partial se_1} = P_{se_1} + \lambda F'(\ ) = 0$$

$$(12)\quad \frac{\partial G}{\partial se_2} = P_{se_2} + \lambda F'(\ ) = 0$$

$$\vdots$$

$$(13)\quad \frac{\partial G}{\partial se_n} = P_{se_n} + \lambda F'(\ ) = 0$$

$$(14)\quad \frac{\partial G}{\partial x_1} = -P_{x_1} + \lambda F'(\ ) = 0$$

$$(15)\quad \frac{\partial G}{\partial x_2} = -P_{x_2} + \lambda F'(\ ) = 0$$

$$\vdots$$

$$(16)\quad \frac{\partial G}{\partial x_r} = -P_{x_n} + \lambda F'(\ ) = 0$$

$$(17)\quad \frac{\partial G}{\partial \lambda} = F(\ ) = 0$$

Henderson and Quandt [1958] showed that solving these first order conditions for any two of the output Equations (10) through (13) demonstrates that the marginal rate of production transformation (MRPT) for every pair of outputs will equal the ratio of their prices, ceteris paribus. This is shown in Equation (18).

$$(18)\quad \frac{P_{se_1}}{P_{se_2}} = \frac{F'(\ )}{F'(\ )} = \frac{\partial se_1}{\partial se_2}$$

This also implies that the value of the marginal product (MVP) of each input with respect to each output will be equal to the ratio of input prices. This is shown in Equation (19).

$$(19)\quad \frac{P_{x_j}}{P_{se_1}} = -\frac{F'(\ )}{F'(\ )} = \frac{\partial se_j}{\partial x_j} \qquad \begin{matrix} \text{for } i = 1, \ldots, n \\ j = 1, \ldots, r \end{matrix}$$

Finally, the ratio of technical substitution (MRTS) for every pair of inputs will equal the ratio of the prices, ceteris paribus. Equation (20) shows this.

$$(20)\quad \frac{P_{x_1}}{P_{x_2}} = -\frac{\partial x_2}{\partial x_1}$$

Scitovsky [1971] has also shown that this will produce the marginal rate of transformation between any two outputs being equated with their marginal cost of production. This is shown in Equation (21).

$$(21)\quad MRPT_{1,2} = \frac{MC_1}{MC_2}$$

for any two outputs.

The processor's derived demand for these grower outputs can also be shown for n services. Equation (22) shows the processor's profit function when several grower services and base good constitute a multiple output for the grower.

$$(22) \quad \pi = P_Y F(B, se) - P_B B - P_{se_1} se_1 - P_{se_2} se_2 - \ldots - P_{se_n} se_n$$

where the variables are as defined.

First order conditions are shown in Equations (23) through (27).

$$(23) \quad \frac{\partial \pi}{\partial B} = P_Y F'(B, se) - P_B = 0$$

$$(24) \quad \frac{\partial \pi}{\partial se_1} = P_Y F'(B, se) - P_{se_1} = 0$$

$$(25) \quad \frac{\partial \pi}{\partial se_2} = P_Y F'(B, se) - P_{se_2} = 0$$

$$\vdots$$

$$(26) \quad \frac{\partial \pi}{\partial se_n} = P_Y F'(B, se) - P_{se_n} = 0$$

These conditions require that the marginal value product of each input be equated to its price. These conditions can be expressed as Equation (27).

$$(27) \quad \frac{MVP_B}{P_B} = \frac{MVP_{se_1}}{P_{se_1}} = \frac{MVP_{se_2}}{P_{se_2}} = \ldots = \frac{MVP_{se_n}}{P_{se_n}}$$

It was suggested in the text that the processor could also supply exchange services to the grower. Thus, a processor supply analysis and a grower derived demand for services would follow the procedure developed here, but roles of each would be exchanged.

Summary

This Appendix demonstrated how individual factors from the "four categories of incentives" could be included in a hedonic price analysis. Elements of risk required modification of the objective function to expected profit rather than profit, and variance of price was included as a measure of the service of price risk reduction. Other elements were incorporated directly.

Solution of first order conditions was demonstrated for situations involving uncertainty, and the criteria of expected profit maximization used as the criterion for selection spot markets or contracts.

Finally, the analysis of one service factor was expanded to n-variable factors. The same criterion of marginal product being equated with price was shown to be appropriate for multiple services, as it was for one service factor.

APPENDIX B
OVERVIEW OF THE EMPIRICAL SETTING

THE EMPIRICAL SETTING: THE HASTINGS, FLORIDA, CHIP POTATO MARKET

Introduction

The theoretical approach to evaluation of alternate vertical exchange mechanisms developed in previous chapters is general in its applicability. Variables were specified only in terms of the "four categories of incentives": risk, technology, market power and transaction costs. The procedure (hedonic price analysis) was shown to be adaptable to analyzing prices from either a spot market or contracting. (Vertical integration cannot be analyzed this way because the intermediate price disappears.) It was shown how and why services could affect observed price of exchange, P_{EX}, either positively or negatively.

This appendix will discuss the specific area and commodity which were selected to test an empirical model developed from this theoretical framework, and to provide a background of the local situation analyzed later. The reason that the Hastings, Florida, chip potato market was selected was that it met the necessary criteria. There is a viable spot market and contracting for chip potatoes in the Hastings area; data were available or it appeared possible to acquire needed primary data from which to conduct the analysis; and it was suggested by some familiar with the industry that the contracts between growers and processors (or brokers) differed significantly in their specifications.

Background and History

This section draws heavily from Norman Rose, Irish Potato Production in Florida--A Historic Data Series [1976]. According to him, the

Hastings, Florida, spring potato area is called the "Tri-County" farming area because it includes areas of Flagler, Putnam and St. Johns Counties. "Flagler County's Haw Creek and Bimini sections dominate the south portion .... Putnam County extends to the south side of Crescent Lake where there is one grower but the principal producing sections are Federal Point, Orange Mill and East Palatka, all southwest of Hastings. . . . St. Johns County, with Hastings as its center as well as the focal point of most activity for the entire area, was and continues to be the leading producer of potatoes. Besides Hastings, it has the Elkton, Spuds, Molasses Junction, Riverdale, Tocoi, Picolata and Mill Creek sections" [Rose, 1976, p. 21].

Mr. Rose indicates that the earliest documented potatoes grown in the area were in the 1889-90 season, amounting to 8 acres. Potatoes increased rapidly in production during the period of 1910 through 1920, and it was during this period that the Florida Potato Growers' Association was formed (September, 1918). In 1922, the Hastings Potato Growers' Association (HPGA) was formed, with a charter membership of 100. Both associations were attempts to help farmers secure necessary inputs. The Florida Potato Growers' Association operated only one season when it orginated, but the HPGA has been in continuous operation.

Financing was a critical factor in the early 1900's, as it is today, and the growers' associations attempted to alleviate this problem growers faced. In 1922, the Florida Crop and Livestock Reporting Service (FCLRS) conducted a survey of financing arrangements in the Hastings area. It was estimated at that time that about 19,000 acres were in production (which is roughly the area today) in the three counties making up the Hastings area (Tables B-1 through B-3). In the survey, it was indicated

Table B-1. Irish Potato harvesting, yields, and total production in the Hastings, Florida area, five-season average, 1933-1968

Five-season average	Acres harvested	Yield per acre (cwt.)	Total production (1,000 cwts)
1929-33	19,680	66	1,299
1934-38	19,040	65	1,238
1939-43	17,010	83	1,412
1944-48	15,820	96	1,519
1949-53	19,620	151	2,932
1954-58	27,640	144	3,814
1959-63	22,440	156	3,514
1964-68	22,580	149	3,368

SOURCE: Florida Crop and Livestock Reporting Service [1976].

Table B-2. Irish Potato harvesting, yields, and total production in the Hastings, Florida area, 1969-70 season to 1979-80 season

Season	Acres harvested	Yield per acre (cwt.)	Total production (1,000 cwts)
1969-70	24,500	165	4,043
1970-71	23,000	132	3,036
1971-72	21,100	142	2,996
1972-73	19,000	180	3,420
1973-74	18,800	175	3,290
1974-75	16,200	195	3,159
1975-76	19,300	210	4,053
1976-77	19,500	220	4,290
1977-78	20,600	170	3,502
1978-79	18,500	230	4,255
1979-80 (estimated)	18,000	250	4,500

SOURCE: Florida Crop and Livestock Reporting Service [1976].

Table B-3. Number of growers, by farm size, Hastings, Florida area, 1958

Size of farm[a]	Estimated number of growers by years			
	1957	1956	1955	1954
Small	183	180	165	151
Medium	61	61	61	54
Large	25	23	23	22
All farms	269	264	249	227

[a]Small, less than 100 acres; medium, 100-249 acres; large, 250 acres and over.

SOURCE: Blair [1961].

that about 90 percent of the growers owned their own farms, about 95 percent were Caucasian; around 30 percent of the potato acreage was grown under total grower financing and about 70 percent was under a form of contract. These contracts were not of the type observed in the area today, but primarily a means of grower financing for their crop. According to Rose, "The dealer writing the contract made cash advances or endorsed the grower's note at a bank. In both cases, 8 percent interest was generally charged. The cash advance averaged about $20.00 per acre. The dealer furnished seed, barrels and sometimes fertilizer" [1976, p. 91]. The grower was apparently free to sell his potatoes either to the contractor or under any other arrangement, and he would then reimburse the contractor in cash payment. Thus, the contracts were in reality a means of grower financing, rather than an attempt to facilitate coordination between grower and processor.

In terms of potato varieties grown, potatoes for chips were not grown at all until the late 1940's, when Graham Lee tried some of his Sebago variety potatoes for chips. Prior to that time, all potatoes had been utilized as table stock. The original variety grown in the Hastings area was the Spaulding Rose #4. It was replaced by the Katahdin, which in turn was replaced by the Sebago. The Sebago was introduced around 1940, and accounted for 95 percent of area production before 1950 [Rose, 1976]. The Sebago is still grown in the area, as a potato which can be sold either as table stock or for chips (which growers like, but processors do not), but at this time the Atlantic variety appears to be dominating the market.

During the 1950's, contracts for potatoes were again introduced, but this time the contracts were from processors, and did not center

around grower financing. A dissertation completed in 1961 by Paul T. Blair summarized the situation for contracting and other grower arrangements during the late 1950's [Blair, 1961]. His study indicated that the first chip potato contract was signed during the 1954-55 season. Eight growers signed contracts during that year (Tables B-4 and B-5). By the 1957-58 season, 65 growers signed contracts for that production year. Rose summarizes: "Contracts for the 1957-58 season specified quality and size from U.S. No. 1, size A to unspecified; price per cwt. was usually on a sliding scale price (79 percent), mostly $2.50-$3.50, that season; the flat rate type made up the other 21 percent, mostly at $3.00. Of the 24 contracting farmers surveyed, 14 agreed to furnish federal-state inspection; 18 agreed to put their potatoes in new bags; and 22 said they were required to supply the bags (Table B-6). An interesting observation was that these contracts were not designed to furnish any credit extension; neither were specific types of transportation required" [1976, p. 59].

Also during the 1960's, studies were conducted to determine if a Federal or State Markeging Agreement and Order should be established. Such a marketing order would have allowed regulation of quality, quantity, diversion of surpluses and packing regulation. A public hearing was conducted by the USDA on November 3-6, 1959, and a referendum was conducted to determine if the marketing order would be established. It failed. During the 1967-68 crop year, however, the North Florida Growers Exchange was organized to facilitate marketing of potatoes in the Hastings area. During its first year, 202 growers representing 73 percent of the area output participated in the Exchange's marketing service. The Exchange still exists, but membership and acreage have

Table B-4. Change in contract volume, size of farm, Hastings area, Florida, 1954-55 and 1957-58

Season	Size of farm			All farms
	Small	Medium	Large	
	Total Volume of Potatoes on Contract (1,000 cwts)			
1954-55	9.5	22.0	23.4	54.9
1957-58	150.4	101.3	132.6	384.4
	Volume on Contract as a Percent of Total Hastings Area Production (1,000 cwts)			
1954-55	0.8	2.0	1.9	1.6
1957-58	12.2	8.8	10.0	10.4

Table B-5. Relation of contract volume to total volume sold by contract growers interviewed, by size of farm, Hastings area, Florida 1954-55 and 1957-58

Season	Size of farm			All farms
	Small	Medium	Large	
	Contract Volume as Percent of Total Sales			
1954-55	30.0	34.6	23.1	26.7
1957-58	43.2	25.7	32.6	32.5
	Volume Contract (1,000 cwts)			
1954-55	2.7	9.0	15.0	26.7
1957-58	42.7	41.5	85.0	169.3

Table B-6. Selected specifications of contracts for the 1957-58 season, by size of farm, Hastings area, Florida

Item	Size of farm			All farms
	Small	Medium	Large	
Quality of potatoes				
U.S. No. 1 Size A	10	4	1	15
U.S. No. 1	--	1	4	5
Percentage U.S. No. 1	1	2	--	3
Unspecified	1	--	--	1
TOTAL[a]	12	7	5	24
Price per hundredweights				
U.S. No. 1, Size A				
$2.50-3.25	2	1	1	4
$2.50-3.50	8	3	--	11
U.S. No. 1				
$2.50-3.25	--	--	2	2
$3.00 flat rate	--	1	1	2
Percentage U.S. No. 1				
$2.00-3.00	1	--	--	1
$3.00 flat rate	--	1	--	1
$4.50 flat rate	--	1	--	1
Unspecified quality				
$2.90 flat rate	1	--	--	1
TOTAL	12	7	5	24
Federal-State Inspection	8	4	2	14
New bags	11	5	2	18
Bags furnished by growers	11	7	4	22

[a] One grower had two contracts.

both declined [Rose, 1976]. Contracting with processors (or brokers who supply processors) has remained a significant influence in the Hastings market, however (Table B-7).

In terms of the significance of the Hastings area production, on a national scale it appears insignificant: less than 2 percent [Blair, 1961]. However, the market was of historic importance because of its production timing. South Florida is one of the few regions in the country which produces fres potatoes during the winter months. Hastings and its surrounding area is one of the few areas in the country which produces fresh potatoes during the spring months. During the 1950's and 1960's, when transportation costs were lower and storage techniques less effective, these two areas of Florida represented an important source of fresh potatoes for both chips and table stock. Historically, the Hastings area has represented about 60 percent of Florida's annual potato acreage [Florida Crop and Livestock Reporting Service, 1976]. This made it an important potato producing area. Improvements in potato storage which have made it feasible to use stored potatoes from the major fall harvest in the northern states has caused the importance of the Hastings area as a potato production site to be questioned.

Current Market Situation

Although production in the Hastings area has been historically significant, recent improvements in storage and potato chip processing techniques appear to have lessened the importance of fresh potatoes for chipping purposes. In the past there has been significant wasteage of potatoes and chips when potatoes are stored for long periods of time and then attempts are made to chip them. The result is wasteage because of

Table B-7. Distribution of the Hastings, Florida area chip potato production, by seasons, 1970-1979

Year	Percent spot market	Percent contract
1970	60	40
1971	51	49
1972	30	70
1973	63	37
1974	66	34
1975	71	29
1976	77	23
1977	68	32
1978	38	62
1979	41	59

SOURCE: Florida Crop and Livestock Reporting Service [1976].

spoiled potatoes which must be discarded when taken out of storage and wasteage of chips which sometimes turn too brown when cooked because some of the starch in the potato has converted to surga and turns unsightly when cooked. (See Smith [1977] for excellent discussion of the technology of storing and producing potato chips.) Table B-8 shows U.S. carryover stocks for 1955-1980, which reflect technology improvement in part. This has lessened dependence of potato chip companies on the winter and spring sources of fresh potatoes for chips, however, and since costs of production for potatoes are higher in Florida than the main areas of production for the country, there appears to have been some price pressure put on area growers in recent years. Table B-9 shows average contract and spot prices between 1970 and 1980, while Table B-10 shows average production costs from 1950 through 1980, inclusive.

Also, although official figures are not available on the number of growers in the area, it appears that the number has decreased by about 50 percent since 1960. Since acreage is approximately the same, this means the average size of operation has increased also since the 1960's.

Finally, in terms of the actual vertical exchange mechanisms, there is no actual auction-type of spot market in Hastings, Florida. The main street houses offices where brokers from throughout the northeast congregate each spring to buy and sell potatoes while the season is in progress. Contracting is also negotiated without benefit of any official organization to oversee operations. Buyers most frequently contract growers by mailing them a contract to sign. Growers wishing to change parties with whom they contract seem to have some freedom of

Table B-8. U.S. potato production and stocks as of March 1 following year, 1955-1980

Year	U.S. product (1,000 cwts)	March 1 stocks (1,000 cwts)
1955-59	165,699	55,958
1960-64	189,447	65,793
1965-69	229,833	82,021
1970-74	265,515	71,962
1975	278,391	104,116
1976	307,427	104,050
1977	307,064	114,140
1978	323,498	120,979
1979	301,628	133,247
1980	---	126,530

Table B-9. Price for Hastings, Florida, potatoes average spot market and contract processed bulk potatoes, 1970-1979

Year	Spot market	Contract
1970	3.54	3.20
1971	4.14	3.25
1972	3.35	3.20
1973	5.93	3.50
1974	6.74	4.75
1975	4.27	4.50
1976	5.04	4.65
1977	5.61	4.50
1978	7.23	4.00
1979	4.19	4.50
1980	--	4.50

Table B-10. Estimates of average costs of production for Hastings, Florida, potato production, 1950-1980

Year	Average costs of production
1950	2.32
1951	2.24
1952	2.50
1953	2.60
1954	2.06
1955	2.43
1956	2.35
1957	2.52
1958	2.32
1959	2.24
1960	2.50
1961	2.06
1962	2.60
1963	2.35
1964	2.32
1965	2.24
1966	2.51
1967	5.47
1968	3.03
1969	2.77
1970	5.03
1971	3.50
1972	3.78
1973	3.11
1974	4.25
1975	4.10
1976	4.08
1977	4.25
1978	4.54
1979	3.98
1980	4.25

movement; however, many growers expressed satisfaction with the buyer they presently deal with.

Growers of the area were provided with the opportunity to form a marketing order during the 1960's, but the measure was narrowly defeated. Although there is grower complaint of suspected malfunctioning of both markets, there is no concerted agreement among growers as to a course of action to follow. It should also be noted in this vein that membership in the Hastings Potato Growers' Association has declined in recent years.

APPENDIX C
SURVEY QUESTIONNAIRES OF HASTINGS CHIP
POTATO GROWERS AND BUYERS WHO
CONTRACTED DURING 1976-1980

Introduction

In order to survey growers and buyers, both personal interviews, telephone interviews and mailed questionnaires were used. Lists of area growers were obtained from official sources, and buyers were interviewed personally, without benefit of official guide. An attempt was made to contact buyers during the market season, and most were interviewed personally at that time. Area grower sampled over a period of three months, and each was guaranteed that his response would be kept in strictest confidence, to insure anonymity. Therefore, only the responses utilized are included with no identification, to insure anonymity of respondents.

CONFIDENTIAL FIRM #_____

Please provide the following information for your firm for this year, and the previous four years, if possible. If not all of the requested information is known, please include that information which is available. Neither the identity of your firm nor the details of these answers will be revealed to anyone in any way.

INFORMATION	YEARS				
	1980	1979	1978	1977	1976
What percentage of plant or firm potatoes were under contract (with growers)?	____	____	____	____	____
What percentage did you contract with processors?	____	____	____	____	____
How many Hastings growers did you contract with?	____	____	____	____	____
Please indicate "Yes" or "No" if you provided growers with information on growing, such as variety or planting and harvesting suggestions.	____	____	____	____	____
Please indicate "Yes" or "No" if contracts with growers specified variety or other special features.	____	____	____	____	____
Please indicate "Yes" or "No" if contracts with processors specified variety or other special features	____	____	____	____	____

Please indicate if you could furnish any of the above information for years previous to 1976.

YES	NO
____	____

What was the first year you contracted with any Hastings grower? _____

Thank you for your help. You will be mailed the results of my analysis for your approval.

DATE _____ CONFIDENTIAL _____ FIRM # _____

INSTRUCTIONS: Please answer the first 11 questions. Then, if you have grown any chip potatoes under contract, complete questions 12-26. Please return the completed questionnaire in the enclosed postage-paid envelope. It will be kept in strict confidence. Thank you.

1. How many years have you been growing potatoes? _____

2. How many acres did you plant to all crops this year? _____

3. Do you have a business interest in a packinghouse? _____

4. Are you a member of the Hastings Potato Grower's Association? _____
   If you are, how many years have you been a member? _____

5. Are you a member of Florida Planters? _____
   If you are, how many years have you been a member? _____

Please write the number of acres in the blanks for each year indicated below. THIS YEAR FIRST

	1980	1979	1978	1977	1976
6. What was the total number of acres you planted for chips?	____	____	____	____	____
7. How many of those acres planted for chips did you rent from someone?	____	____	____	____	____
8. How many acres of cabbage did you plant?	____	____	____	____	____

Please answer the next questions "Yes" or "No."

9. Did you get a loan from a bank, Production Credit Association (PCA) or other lending agency?	____	____	____	____	____
10. Did you contract to BUY any chip potatoes from other growers?	____	____	____	____	____

CONTINUE if you DID sign a contract to sell chip potatoes for any of the years asked in question #11 above. If you did NOT contract, please return this form as soon as possible.

		1980	1979	1978	1977	1976
12. How many 100 lb. bags or acres were specified in each contract? (Use whichever was in your contract.)	bags	____	____	____	____	____
	acres	____	____	____	____	____
13. If the contract was on a sliding scale, what was the price range?		____	____	____	____	____
14. What was the final price (or price range) you received for your contract potatoes?		____	____	____	____	____
15. What month did you sign the contract?		____	____	____	____	____
16. How much money were you loaned as part of your potato contract?		____	____	____	____	____
17. About how many days after harvest was it before you were paid for your contract potatoes?		____	____	____	____	____
18. Who determined when the potatoes were harvested (Circle M for me, C for contract)?		M C	M C	M C	M C	M C

Please answer "Yes" or "No" to the following questions:

19. Did the contract specify a harvest date?		____	____	____	____	____
20. Did the contract specify a variety?		____	____	____	____	____
21. Did the contract specify a grade?		____	____	____	____	____

	1980	1979	1978	1977	1976
22. Did the contract have any other conditions?	____	____	____	____	____

23. Please list conditions, if any_____

_____

_____

24. Please give the name of the party or firm with whom you contracted each year for 1976-1980, inclusive. Indicate "none" for years you did not contract any potatoes.

1980_____

1979_____

1978_____

1977_____

1976_____

25. For each different buyer you contracted with, what was the total number of years you signed with him?

1980_____

1979_____

1978_____

1977_____

1976_____

26. Other comments: _____

_____

_____

_____

_____

_____

Table C-1. Data for Logit analysis

DCON	DPCA	DGA	DPKHS	ACRE	FMAGE
1	0	0	0	460	40
1	1	0	0	200	4
1	1	0	0	370	30
1	1	1	0	54	10
1	1	0	0	600	19
1	1	0	1	1624	14
1	1	0	1	1330	20
1	1	0	0	80	6
1	1	0	1	900	15
1	1	0	0	80	40
1	1	0	1	500	6
1	1	1	1	750	58
1	0	0	1	1100	20
1	1	0	0	720	24
1	1	0	0	280	20
1	1	0	0	520	20
1	1	0	0	70	4
1	1	0	1	700	22
1	1	0	0	800	24
1	1	0	0	200	50
0	1	1	0	80	15
0	0	1	0	20	25
0	0	0	0	20	80
0	0	1	0	168	6
0	1	1	0	40	14
0	1	1	0	20	24
0	1	1	0	40	23
0	0	1	0	60	22
0	0	1	0	60	21
0	0	0	0	140	78
0	1	1	0	40	14
0	0	0	0	100	77
0	0	0	0	120	76

Table C-2. Data for hedonic price analysis of contract market

D1	D2	D3	D4	QUAL	PCA	HVSAY	PFMCON	VARSP	INFO	DPR	DELAY
1	0	0	0	1	0	-1	43	0	1	1.95652	30
0	1	0	0	1	0	-1	41	0	1	1.76349	70
0	0	1	0	1	0	-1	77	0	1	2.02381	70
0	0	0	1	1	0	-1	57	0	1	2.32240	70
-1	-1	-1	-1	1	0	-1	32	0	1	2.28495	70
1	0	0	0	1	1	0	100	0	1	1.84783	80
0	1	0	0	1	1	0	100	0	1	1.76349	80
0	0	1	0	1	1	0	100	0	1	2.02381	80
0	0	0	1	1	1	0	100	0	1	2.59563	80
1	0	0	0	1	1	-1	100	0	0	1.95652	7
0	1	0	0	1	1	-1	100	0	0	1.76349	7
0	0	1	0	1	1	-1	100	0	0	2.14286	7
0	0	0	1	1	1	-1	100	0	0	2.45902	7
-1	-1	-1	-1	1	1	-1	100	0	0	2.68817	7
1	0	0	0	1	1	-1	43	1	1	1.95652	150
0	1	0	0	1	1	-1	67	1	1	1.86722	150
0	0	1	0	1	1	-1	90	1	1	2.14286	150
0	0	0	1	1	1	-1	47	1	1	2.73224	150
-1	-1	-1	-1	1	1	-1	32	1	1	2.33871	150
1	0	0	0	1	1	-1	44	0	0	1.95652	40
0	1	0	0	1	1	-1	87	0	0	1.86722	40
0	0	1	0	1	1	-1	39	0	0	2.14286	40
0	0	0	1	1	1	-1	9	0	0	2.73224	40
-1	-1	-1	-1	1	1	-1	16	0	0	2.41935	40
1	0	0	0	0	1	-1	27	0	0	1.84783	45

Table C-2. Continued

D1	D2	D3	D4	QUAL	PCA	HVSAY	PFMCON	VARSP	INFO	DPR	DELAY
0	1	0	0	0	1	-1	43	0	0	1.76349	45
0	0	1	0	0	1	-1	44	0	0	1.97619	45
0	0	0	1	0	1	-1	34	0	0	2.26776	45
-1	-1	-1	-1	0	1	-1	27	0	0	2.01613	45
1	0	0	0	0	1	-1	27	0	0	1.84783	45
0	1	0	0	0	1	-1	43	0	0	1.76349	45
0	0	1	0	0	1	-1	44	0	0	1.97619	45
0	0	0	1	0	1	-1	34	0	0	2.26776	45
1	0	0	0	1	1	0	30	1	0	1.95652	30
0	1	0	0	1	1	0	25	1	0	1.76349	30
0	0	1	0	1	1	0	43	0	0	2.14286	30
0	0	0	1	1	1	0	57	0	0	2.45902	30
-1	-1	-1	-1	1	1	0	34	0	0	2.68817	30
1	0	0	0	1	1	1	60	1	0	1.95652	40
0	1	0	0	1	0	1	60	1	1	1.86722	40
0	0	1	0	1	0	1	75	1	1	2.02381	40
0	0	0	1	1	0	1	60	1	1	2.32240	40
-1	-1	-1	-1	1	0	1	60	1	1	2.28495	40
1	0	0	0	1	1	1	60	1	0	1.95652	40
0	1	0	0	1	0	1	60	1	0	1.86722	40
0	0	1	0	1	0	1	75	1	0	2.02381	40
0	0	0	1	1	0	1	60	1	0	2.32240	40
-1	-1	-1	-1	1	0	1	60	1	0	2.28495	40
1	0	0	0	1	1	-1	100	0	0	1.84783	30
0	1	0	0	1	1	-1	100	0	0	1.65975	30

Table C-2. Continued

D1	D2	D3	D4	QUAL	PCA	HVSAY	PFMCON	VARSP	INFO	DPR	DELAY
0	0	1	0	1	1	-1	34	0	0	2.02381	30
0	0	0	1	1	1	-1	34	0	0	2.45902	30
-1	-1	-1	-1	1	1	-1	35	0	0	2.41935	30
1	0	0	0	1	1	-1	100	0	0	1.84783	60
0	1	0	0	1	1	-1	100	0	0	2.01245	30
0	0	1	0	1	1	-1	100	0	0	2.14286	14
0	0	0	1	1	1	-1	100	0	0	2.45902	14
-1	-1	-1	-1	1	1	-1	100	0	0	2.52688	60
1	0	0	0	1	1	0	100	0	0	1.95652	30
0	1	0	0	1	1	0	100	0	0	1.86722	30
0	0	1	0	1	1	0	100	0	0	2.14286	30
0	0	0	1	1	1	0	100	0	0	2.45902	30
-1	-1	-1	-1	1	1	0	100	0	0	2.41935	30
1	0	0	0	1	1	-1	63	0	0	1.84783	30
0	1	0	0	0	1	0	51	0	0	1.76349	30
0	0	1	0	0	1	0	59	0	0	2.02381	30
0	0	0	1	1	1	-1	49	0	0	2.32240	180
-1	-1	-1	-1	1	1	-1	48	0	0	2.28495	75
1	0	0	0	1	1	0	64	1	0	1.95652	15
0	1	0	0	1	1	0	54	1	0	1.86722	70
0	0	1	0	1	1	0	74	1	0	2.14286	70
0	0	0	1	1	1	0	57	1	0	2.32240	70
-1	-1	-1	-1	1	1	0	60	1	0	2.28495	70
1	0	0	0	1	0	1	44	1	0	1.95652	30
0	1	0	0	1	0	1	43	1	0	1.86722	30

Table C-2. Continued

D1	D2	D3	D4	QUAL	PAC	HVSAY	PFMCON	VARSP	INFO	DPR	DELAY
0	0	1	0	1	0	1	75	0	0	2.14286	30
0	0	0	1	1	0	1	64	0	0	2.45902	30
-1	-1	-1	-1	1	0	1	70	0	0	2.41935	30
1	1	0	0	1	1	0	33	0	1	1.95652	30
0	0	0	0	1	1	0	37	0	1	1.76349	30
0	0	1	0	1	1	0	50	0	1	2.02381	30
0	0	0	1	1	1	0	39	0	1	2.59563	30
-1	-1	-1	-1	1	1	0	41	0	1	2.41935	30
1	0	0	0	1	1	-1	43	1	1	1.84783	30
0	1	0	0	1	1	-1	25	1	1	1.76349	30
0	0	1	0	1	1	-1	78	1	1	2.02381	30
0	0	0	1	1	1	-1	52	1	1	2.59563	30
-1	-1	-1	-1	1	1	-1	55	1	1	2.41935	30
1	0	0	0	1	1	1	100	0	0	1.95652	30
0	1	0	0	1	1	1	100	0	0	1.86722	30
0	0	1	0	1	1	1	100	0	0	2.02381	30
0	0	0	1	1	1	1	100	0	0	2.45902	30
-1	-1	-1	-1	1	1	1	100	0	0	2.41935	30
1	0	0	0	0	1	0	100	0	1	1.95652	2
0	1	0	0	0	0	0	100	0	0	1.76349	2
0	0	1	0	0	0	0	100	0	0	2.02381	2
0	0	0	1	0	0	0	100	0	0	2.04918	2
1	0	0	0	1	1	-1	68	0	0	1.95652	90
0	1	0	0	1	1	-1	50	0	0	1.65975	60
0	0	1	0	1	1	-1	84	0	0	2.02381	30

Table C-2. Concluded

D1	D2	D3	D4	QUAL	PAC	HVSAY	PFMCON	VARSP	INFO	DPR	DELAY
0	0	0	1	1	1	-1	57	0	0	2.18579	30
-1	-1	-1	-1	1	1	-1	60	0	0	2.15054	30
1	0	0	0	1	1	-1	60	0	0	1.95652	30
0	1	0	0	1	1	-1	48	0	0	1.76349	60
0	0	1	0	1	1	-1	141	0	0	2.02381	60
0	0	0	1	1	1	-1	99	0	0	2.45902	60
-1	-1	-1	-1	1	1	-1	79	0	0	2.41935	60

Table C-3. Data for hedonic price analysis of spot market

YR	DBLK	SMACVA	DFCMP	DFSMP	DFCOM	TSHIP	TRD
50	0	0.010	0.0000	2.40777	0.242718	0.510956	1
51	0	0.003	0.0000	2.02479	0.206612	0.393823	1
52	0	0.090	0.0000	3.17391	0.217391	0.611290	1
53	0	0.110	0.0000	2.12745	0.245098	0.535755	1
54	0	0.001	0.0000	2.45918	0.255102	0.567036	1
55	0	0.010	0.3763	2.79570	0.268817	0.678886	1
56	0	0.090	0.0000	3.69565	0.271739	0.755527	1
57	0	0.230	0.0000	1.82979	0.265957	0.862732	1
58	0	0.020	0.0000	2.40000	0.250000	0.767746	1
59	0	0.000	0.0000	2.66667	0.260417	0.827158	1
60	0	0.090	0.0000	3.86316	0.263158	0.836617	2
61	0	0.020	0.0000	2.12500	0.260417	0.358161	2
62	0	0.004	0.0000	2.91837	0.255102	0.645721	2
63	0	0.040	1.2887	2.31959	0.257732	0.481493	2
64	0	0.110	-1.3158	3.62105	0.263158	0.586476	2
65	0	0.700	0.0000	4.54082	0.255102	0.528197	2
66	0	0.020	0.0000	3.08491	0.235849	0.502644	2
67	0	0.060	0.0000	3.25000	0.250000	0.514731	2
68	0	0.020	0.2451	3.08824	0.245098	0.578923	2
69	0	0.010	0.5607	2.71963	0.233645	0.607583	2
70	0	0.310	0.9091	2.99091	0.227273	0.657804	2
71	1	0.010	-0.5310	3.44248	0.221239	0.788373	2
72	1	0.140	1.6000	2.48000	0.200000	0.893858	2
73	1	0.410	-1.3966	3.17318	0.139665	0.887135	2
74	1	0.110	0.2604	3.38021	0.130208	0.912158	2
75	1	0.050	-0.2703	2.17297	0.135135	0.936056	1
76	1	0.001	-0.1344	2.57527	0.134409	0.907229	1
77	1	0.003	-0.1366	2.92896	0.136612	0.838345	1
78	1	0.110	0.0381	3.32381	0.119048	0.925614	1
79	1	0.020	0.4730	1.63485	0.103734	0.934759	1
80	1	0.070	0.4913	2.17391	0.108696	0.912825	1

APPENDIX D
LEAST SQUARES WITH DUMMY VARIABLES AND VARIANCE COMPONENTS, HEDONIC PRICE ANALYSES OF CONTRACTING

Table D-1. Results of least squares with dummy variables hedonic price analysis of contracting

Variable	Estimated coefficient	Standard error
Intercept	2.00	0.078
D1	-0.20	0.020
D2	-0.30	0.019
D3	-0.04	0.020
D4	0.31	0.020
D11	-0.12	0.095
D12	0.04	0.058
D19	0.32	0.140
D52	0.31	0.013
D77	0.16	0.114
D80	0.13	0.107
D92	0.006	0.050
D113	-0.03	0.071
D124	0.11	0.153
D129	0.20	0.109
D131	0.08	0.236
D132	0.22	0.120
D4a	0.02	0.098
D134	-0.01	0.158
D136	-0.08	0.050
D106	0.007	0.113
D200	0.002	0.116
DELAY	-0.0005	0.0006
PFMCON	-0.0003	0.0006
DTHV	-0.04	0.099
HVSAY	-0.09	0.056
VARSP	-0.11	0.061
INFRO	0.02	0.054
QUAL	0.16	0.050
PCA	0.13	0.058

Statistics for Model:	
MSE	= 0.0094
R^2	= .90
F Ratio	= 28.47
Standard Error	= .009

Table D-2. Test for pooling cross-section of growers in hedonic price analysis of contracts

Hypothesis to be tested:

H_0: $a_1 = a_2 = \ldots = a_n$ Ha: $a_1 \neq a_2 \neq \ldots \neq a_n$

$b_1 = b_2 = \ldots = b_n$ $b_1 \neq b_2 \neq \ldots \neq b_n$

where n is the number of firms.

Test:

$$F_{calc.} = \frac{(SSE_2 - SSE_1) / (2N - 2)}{SSE_1 / (Obs. - 2N)} = \frac{1.067 - .7550 / 32}{.7550 / 65}$$

$$= .967$$

Rejection criterion:

Reject H_0 if $F_{calc.} > F_{61}^{36}$ at $\alpha = .05$ level

Conclusion:

F_{61}^{36} at .05 level = 1.56.

Therefore, do not reject H_0.

Table D-3. Test for utilizing variance components in hedonic price analysis of contracts

Hypothesis to be tested:

H_0: $\sigma_\mu^2 = 0$

H_a: $\sigma_\mu^2 \neq 0$ where μ is the random effect among firms.

Test:

$$\text{Test}_{\text{calc.}} = \frac{NT}{2(T-1)} \left[\sum \left(\sum_{i=1}^{T} \hat{\varepsilon}_{it} \right)^2 - 1 \right]^2 = 1.125 \ (.0629)$$

$$= 0.0708$$

Rejection criterion:

Reject H_0 if $\text{Test}_{\text{calc.}} > \chi_1^2$ at $\alpha = .05$ level.

Conclusion:

χ_1^2 at .05 level = 3.841

Therefore, do not reject H_0.

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Ella Kay Carl was born on April 3, 1950, in Buffalo, New York. She spent the first 18 years of her life on her parent's beef cattle farm in western New York State. In 1969, she married Emerson B. Carl and moved to Gainesville, Florida. She completed a B.A. and M.A. in English from the University of Florida, and in 1978 she received a M.A.M.R.D. degree in food and resource economics.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Leo Polopolus, Chairman
Professor of Food and Resource Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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